THE
ELECTRICAL REVIEW.

VOL. LXII. JANUARY 31, 1908. No. 1,575.

ELECTRICAL REVIEW.

Vol. LXII.] CONTENTS: January 31, 1908. [No. 1,575.

	Page
Car Axles	161
The Earthing of the Neutral of Transformers	162
Establishment Charges	162
Cost and Accounting Systems	163
Engineering and Socialism	163
The Greenwich Boiler Explosion	164
The Design of Small Transformers for Metallic Filament Lamps (*illus.*)	164
Porcelain Insulators for 100,000 Volts (*illus.*)	167
Legal	167
Parliamentary	170
Our Legal Query Column	171
Correspondence:— Wireless Telegraphy; Electrical Cooking and Heating Appliances—Why they do not Sell; Production of Energy from Peat; The City Lighting and Measurement of Illumination; Heat-Dissipating Varnishes; Gas *v.* Electricity; Limits of Municipal Engineers' Authority; Electricity in Bulk; The Use of Ball Bearings on Electric Motors; Detrimental Circulars; Review of a Review; Thermal Storage; Unadvertised Appointments	171 to 177
Business Notes	177
Curtis Turbines in the U.S.A. (*illus.*)	181
Pay-as-you-Enter Cars in Buffalo (*illus.*)	184
Notes	187
City Notes	189
Stocks and Shares	192
Electric Tramway and Railway Traffic Returns	192
Share List of Electrical Companies	193
Exports and Imports of Electrical Goods during Dec., 1907	195
Gas-Tight Switches	196
The Use of Heater-Detartarisers	197
The Effect of Temperature on Transformers	198
Proceedings of Institutions:— The Heat Conductivity of Iron Stampings (*illus.*)	199
Cost of Electrical Power for Industrial Purposes	201
The Electrification of Railways	203
New Patents Applied For, 1907	204
Published Specifications	204

THE ELECTRICAL REVIEW.

Published every FRIDAY Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGREKAY, LONDON." Code, A B C.

Telephone Nos. Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 19s. 6d., Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).
1908 EDITION
NEARLY READY.
H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

CAR AXLES.

A RECENT accident at Bradford was attributed by the Board of Trade Inspector to the breakage of one of the driving axles at a critical moment. The only wonder in our minds is why serious accidents arising from this cause are so very rare, for we imagine that not a day passes but at least one axle breaks in England alone, and we have known cases in which three cars have been disabled in this manner on the same day, and on the same tramway. This sort of thing has been going on now for at least five years, and there can be little doubt that the additional burden of top-deck covers has done nothing to improve the position, although we are by no means of the opinion that this is a factor of particular importance. Sometimes, no doubt, the top-cover has been the last straw that has broken the camel's back, but the catastrophe has been hastened only, not produced, by the extra imposition on an already overstrained axle.

Our contemporary, the *Light Railway and Tramway Journal*, ever ready to elicit categorical opinions upon matters which deeply affect the operation of tramways as a whole, has seized the opportunity presented by the publication of Lieut.-Col. Druitt's Bradford report, and several pages of the January number are occupied by the replies of engineers and managers to 10 questions, which were framed with the purpose of ascertaining the general practice with regard to the design of car-axles.

A survey of the replies leaves us with a sense of disappointment, for in a very small number of cases does it appear that any serious effort has been made to eliminate what everyone has recognised as the weak points ever since axles began to break frequently.

The first trucks which were largely used on British tramways were of American manufacture, and the axles had a maximum diameter of $3\frac{3}{4}$ in., but this was reduced at the journal seats to $3\frac{1}{2}$ in. or less, and sometimes the wheel seats were reduced also.

Another weak place was introduced invariably at the gear-wheel key-seating, which was a rectangular channel, from $\frac{1}{2}$ in. to $\frac{5}{8}$ in. deep, with sharp angles at the bottom.

While the track remained in fair order, while car weights were moderate, and while the motors were comparatively feeble, these axles gave little trouble; but the time came when all these conditions were altered for the worse, yet the general design of the axle altered not. It is not strange, therefore, that axles have given way, and a continuance of the trouble, with perhaps an occasional serious accident, must be expected until there are no more obsolete axles in use.

Lieut.-Colonel Druitt puts the whole matter in a nut-shell in the following sentence:—

> The failure of this (Bradford) and other similar axles is, I think, due to their not being of sufficient diameter to withstand the rapid alternation of equal tensile and compressive stress put on them, to the constant shocks received on sharp curves and at points and crossings, and to the frequent application of the wheel brakes.

He mentions, also, that the percentages of sulphur (·047 per cent.) and of phosphorus (·053 per cent.) are rather high, the British standard specification for railway axles providing that neither of these constituents shall exceed ·035 per cent.

A fair number of tramways specify mechanical tests for new axles, but few of them take heed to the chemical analysis. Croydon is one of the exceptions, but in that case the permitted limit is ·06 per cent., or nearly double that allowed by the B.S.S.

On some tramways nearly all fractures occur at the outer end of the gear-wheel key seat, but on others, as, for instance, Leeds and London (L.C.C.), they take place usually at the inner end of the car-wheel seating.

The obvious remedy is to enlarge the diameter of the axle at the car-wheel and gear-wheel seats, and to modify or remove the gear-wheel key way, but to readers of the ELECTRICAL REVIEW this is ancient history.

Solid gear wheels have been available for tramcars for some years, and we believe that they have given eminently satisfactory results wherever they have been used. They are pressed on to the full diameter of the axle, and require no key. There are certain disadvantages attaching to the solid wheel, especially where steel tires are in use; but we think that none of them are so serious as to prohibit its adoption. An alternative is a special form of key having its lower surface cut to the arc of a circle of large radius.

The *Light Railway and Tramway Journal* makes a good point in drawing attention to the entire freedom from fractured axles at Leicester, and the breakage of one only at Hull, this immunity being attributed to the easy conditions of operation, as both lines are almost level.

It is to be hoped that those responsible for the working of all tramways, large and small, will not be deterred from bringing their axles up to the higher standard which the present and increasingly onerous traffic conditions demand, by any thought of the trouble or the expense which may be involved in altering other parts of the truck to suit the enlarged axles.

The Earthing of the Neutral of Transformers.

THE question of the proper means which should be adopted for the earthing of secondary circuits was brought up in Canada at the recent convention of the Association of Electrical Engineers, and there it was pointed out that the underwriters would not allow the earthing of one terminal of the low-pressure transformer if no neutral tapping were provided. This attitude is almost inexplicable. The extra stress imposed on one side of a 110-volt two-wire system, due to earthing the other side, is negligible in view of the high class of insulation and workmanship that is used at the present day.

The greatest risk in supplying transformers is, of course, the breaking down of insulation between the high-tension and low-tension windings. Now if there were no earth point on the low-tension side, this contact of the two sets of windings might not affect the lights, but would constitute a most serious danger, inasmuch as the wiring in the consumer's premises would possibly be raised to a dangerous potential. Should this occur, the insulation would be almost certain to break down and a high-tension arc would be started, possibly at a point where there was considerable chance of harm being done. If, however, one side of the low-tension transformer were securely earthed, the bad effect of contact between the windings would at once be neutralised by the blowing of the fuses on the high-tension side, and there would be no risk of further harm.

Theoretically, the best way would be to bring out a tapping from the centre coils of the low-tension winding and earth this point, but it is perfectly understandable that the manufacturers object to having tappings on their transformers, and prefer to do without them if possible. The modern English practice (except in very small areas of supply) is to run the distributing network at 220 volts pressure, and the difficulty may be overcome by adopting two 110-volt transformers in series and earthing the point of junction between the two.

Establishment Charges.

THE keeping of accurate accounts to show the expenditure in labour and material upon each order is now deemed absolutely necessary in every up-to-date engineering works. Records for this purpose are easily obtained, and if the total cost of making a machine or part were confined to these two items, estimating would be a comparatively simple matter. A very large proportion of the total cost of manufacturing is unfortunately made up of what are known as general shop charges, such as rent, rates and taxes, lighting and heating, interest, depreciation, general shop labour, supervision, &c., the correct charges for these items being much more difficult to fix than those for labour and material.

The method, usually adopted, of adding a percentage to the labour cost to cover shop charges, is open to the objection that no account is taken of the time occupied or the size of machine tool employed; hence the charges upon a job which takes 10 hours to perform upon a small lathe will be very nearly the same as for a job occupying a large boring mill for a similar period, the only difference being the slightly higher pay given to the man on the larger machine. The latter takes up more space, for which rent, rates and taxes, lighting, heating, interest (for buildings), &c., have to be paid, and a much heavier cost is involved for power, interest (for machine), depreciation, repairs, &c., than is the case with the smaller tool.

To a certain extent the incorrectness of the "percentage on labour" system is modified by the introduction of piecework and the division of the machine shop into sections, but in principle this plan is obviously wrong and must eventually give way to more accurate methods.

To fix the percentage above mentioned, the ratio of productive labour to shop charges is obtained for certain periods, usually of six months' duration, and the resulting percentage is used until the figures are taken out again. The plan results in a high percentage during slack times, and a low figure when the shops are full of work, and is no doubt useful for indicating the efficiency of the works. On the other hand, a percentage obtained in this manner is useless for the purpose of showing how far prices may be reduced to obtain orders, which is a most important function of any prime cost system.

For example, during a busy period following a slack time, the allowance for establishment charges would be too high, whereas the opposite would obtain when a busy time was followed by a slack period. This drawback to the "percentage on labour" system may be minimised by modifying the figure, for estimating purposes, in accordance with existing conditions, the most important disadvantage of the plan being its incorrectness when applied to individual orders.

There would appear to be no reason why certain items such as rent, rates and taxes, power, lighting, heating, interest, repairs, &c., should not be charged up direct to each machine in the form of a machine rate, based upon the assumption that the work is steadily proceeding throughout the day. This system was first put forward by Mr. Hamilton

Church in the *Engineering Magazine* during 1901, and very similar methods have been recently advocated by Mr. Arthur Winder in *Cassier's Magazine*.

It is obvious that if all the machines were fully occupied, the total of the machine rates during a certain period should exactly equal the general shop charges, but as such ideal conditions never obtain the total of the machine rates is always less than the sum of the shop charges, and this difference according to Mr. Church's method is distributed over the various jobs as a supplementary rate, each job being charged in proportion to its total for machine rates. The supplementary rate is an excellent indicator of the efficiency of the shops, as it will rise as the output falls below the maximum.

The principles put forward above for machine shops may also be applied to fitting, erecting and other departments in which the labour is directly charged to the jobs. Each workman takes up a certain amount of space in the building which has to be warmed and lighted, he also requires a certain equipment in the form of a bench, vice, tools, &c., these items, together with the space occupied, forming a basis upon which to fix a machine rate.

Amongst the advantages of this system for the allocation of shop charges is the existence of accurate figures showing the time, wages and indirect charges upon each job, thus offering especial facilities for studying the effect of new tools and processes, and the advantage or otherwise of employing highly-paid workmen.

Establishment charges in the form of management, bookkeeping, advertising, travelling, patterns, drawings, &c., still have to be provided for, and the distribution of these general charges over the various products may be based upon: (*a*) labour only; (*b*) labour, material and shop charges; (*c*) the number of hours occupied in the production.

For manufacturing purposes, Mr. Church recommends the adoption of method *(c)*, but whatever basis of distribution is chosen, the allocation of general charges to certain classes of product can only be decided upon after very careful consideration of the conditions under which each species of goods is manufactured.

It will be obvious that patented articles or machines in steady demand, and which require little attention on the part of the drawing office and the sales department, should bear a much lower proportion of general charges than large plant, which has to be especially designed, and whose sale occupies much time and travelling by salesmen or experts.

This question of correctly allocating shop and general charges to each manufacturing order is becoming of greater importance from year to year as competition increases in intensity, and when it is borne in mind that the cost of these items often exceeds the total for labour, the need for effective methods is clearly demonstrated.

Cost and Accounting Systems.

PERHAPS it is because we are brought more into touch with electrical manufacturers and contractors than with some other trades that we hear so much of electrical work being done below cost price, or at impossible prices. It may be that the same condition of affairs holds in other trades. The reason, or one of the reasons, is that comparatively few firms know precisely what their work costs, because they do not properly analyse and sub-divide their cost sheets.

In order to estimate properly, it is essential that very careful and systematised records of costs be kept. It is not enough to know the approximate cost of wages, and the approximate cost of material, and then add a percentage, based upon nothing more reliable than guess work, to cover management expenses and standing charges. It is just this rough and ready kind of estimating that accounts largely for the great differences which are generally seen between the highest and lowest tender for any job offered for open competition. It is perhaps not sufficiently recognised that standing charges are a varying quantity, and many firms adopt the method of adding a definite percentage to their costs to cover this item no matter whether they are busy or slack. When a difference is made, it is usually on the unsound principle of quoting lower prices when business is slack, that is to say, that firms quote what they consider to be a sufficient price to cover the actual cost without reckoning standing charges, whereas when they are busy they would quote higher prices because they are not so keen on getting the orders. Whilst this may average out more or less satisfactorily, it is a very unscientific method of estimating. In slack times the standing charges form a greater percentage of the total costs of each individual piece of work than in busy times, so that when a firm quote a low price during a slack time period they are really cutting the margin of profit finer than they think. In point of fact, the prices quoted would, if the correct standing charges were added to the actual cost of the job, mean a certain loss instead of the small profit which they think they are providing for. This kind of thing cannot, of course, go on indefinitely, and it is only the fact that in busier times an excessive percentage is added for standing charges that saves a good many firms from bankruptcy.

In the *Business Man's Magazine* for November, an article by F. A. Smith contains a number of sample cost forms designed for electrical manufacturers. Whilst these may suit some firms, it does not necessarily follow that they are universally applicable to all electrical manufacturing concerns. We are not believers in too much system, as it is possible for systems to involve more labour and expense than they save, but we do believe that there is considerable room for improvement in the matter of accurate cost keeping, which is a vital necessity if a firm is to conduct its business on a sound basis.

Engineering and Socialism.

IT was too bad of the Labour Party Congress to put such a severe strain on the leader writers of the daily Press as they did last week. On one day they rejected by an overwhelming majority the proposal to adopt the Socialistic ticket, and practically every newspaper in the country had a leading article commending the Trade Unionists for declining to swallow the Socialistic bait dangled before them. The leader writers were set a most difficult task the following day, when they had to explain away the fact that the Labour Party Congress had performed a complete *volte face*, and had, by a considerable majority, accepted the motion proposed by the representative of the Amalgamated Society of Engineers, committing the Labour Party to the Socialistic programme. The daily gramaphone Press were able to climb down pretty easily, by saying that the Labour Congress had accepted their advice to drop the mask of hypocrisy and declare openly that their ultimate object was to Socialise the Labour Party. It is of peculiar interest to us that the motion was proposed by the engineering delegates. Its terms were as follows:—

"That, in the opinion of this Conference, the time has arrived when the Labour Party should have as a definite object the Socialisation of the means of production, distribution and exchange, to be controlled by a Democratic State in the interest of the entire community, and the complete emancipation of labour from the domination of capitalism and landlordism, with the establishment of social equality between the sexes."

The voting was, for the Socialists 514,000, and against 465,000; and we read that in a moment after the announcement of the figures the entire Congress was a mob of shouting and yelling delegates, the Socialists, led by that freelance, Victor Grayson, singing the Socialists' anthem, "Keep the Red Flag Flying."

One thing is certain, viz., that the vote will mean the breaking up of the Labour Party into groups; and from one point of view it is well that the aims of the irresponsible Socialists of the party should be fully understood now rather than later, so that the more sober and representative members of Trade Unionism can dissociate themselves from the small section of revolutionary Socialists with whose aims they are not in sympathy. It will be necessary in

forthcoming elections for a Labour candidate to declare definitely whether or not he stands as a Socialist, and is prepared to adopt the full Socialist ticket. We are perfectly sure that the majority of the rank and file of the A.S.E. are not truly represented by their delegates at the Labour Congress.

The Greenwich Boiler Explosion.

CONSIDERATION of the conduct and conclusions of the recent inquiry, apart from its technical aspect, impels us to express our strong dissatisfaction with the terms of the judgment, which were briefly noted in our last issue. The Board of Trade investigations into boiler explosions were originally of a purely technical character, and as such they have been of the greatest utility to engineers and manufacturers. Not only have they elucidated the causes of mysterious accidents, but they have frequently fixed the responsibility for them, and have thus kept owners and users alive to the gravity of their obligations to the public in general and their employés in particular. But there appears to be a tendency to turn these technical investigations into judicial inquiries, in which the persons concerned are placed actually upon their trial, before tribunals of a character which is by no means proper to the purpose. Witnesses are badgered by counsel who cannot and do not possess adequate knowledge of the highly technical questions involved; and instead of doing their best to throw light upon the subject of inquiry, when they unexpectedly find themselves in the position of defendants, they will naturally be driven to reticence, lest they should commit themselves to statements prejudicial to their own interests. Such methods savour rather of Continental than of British practice. The power of ordering the various parties to pay part of the costs of the inquiry can also be, and in fact is, utilised as a means of inflicting heavy fines upon them. This is not as it should be. The Commission should confine itself to ascertaining facts and fixing responsibility; punishment for misdemeanour or negligence should be dealt out by a properly constituted Court of Justice, before which the persons accused would be enabled and prepared to present their own cases to the best advantage.

These considerations are borne in upon us by the judgment in this case. Not only have the boiler makers been heavily fined, largely, as stated in the judgment, as a punishment for their endeavour to cast the blame upon other parties (the makers of the plate), but also the engineers, Mr. H. W. Bowden and Mr. J. A. Constable, have been severely dealt with by the imposition of fines, and by an allegation of incompetence calculated to do them far more injury than the mere value of the fine.

The injustice of such an accusation must be palpably evident to those who are acquainted with the respective careers of these gentlemen, both of whom, as a matter of fact, have had constant experience in the management of steam boilers for a period of at least seventeen years. So far as we can ascertain, no attempt was made by the Commissioners to obtain information as to their engineering records and training, and apparently they were thus heavily censured because they did not, and could not, know, from the existence of a minute crack on the external surface of the drum-end, that the plate was cracked for two-thirds of its periphery, and was holding on by a mere shred of metal.

It is all very well to criticise in the light of subsequent knowledge; it is, however, certain that not one of the engineers who inspected the boiler regarded the crack as dangerous, and it is highly significant that even the expert boiler inspector, Mr. Shaw, who was killed —according to his chief, Mr. Hiller, the best man the Insurance Co. had in the district—made no suggestion that the boiler should be shut down, nor did he hesitate to continue his personal examination of it under steam. It seems to us that Mr. Bowden, as chief engineer, did all that any other experienced engineer, mechanical or electrical, would have done under like conditions, and that the implied disparagement of his ability, as well as that of his assistant, Mr. Constable, is unjust in the extreme.

THE DESIGN OF SMALL TRANSFORMERS FOR METALLIC FILAMENT LAMPS.

BY F. B. O'HANLON.

NOT very many years ago great things were prophesied for the high-voltage carbon filament lamp. The station engineer called it a blessing, as it gave a new lease of life to his overloaded mains and enabled him to reduce his copper losses. The consumer, after a short experience with it, especially in small sizes, called it something else, and said it more emphatically. Now we have various high-efficiency metallic filament lamps, but unfortunately the smaller units of these cannot be obtained for voltages of 100 or thereabout, and even if they could be obtained, the extreme fineness and want of mechanical strength of the filaments would probably tell heavily against them.

At 25 volts, however, the case is quite different; Osram lamps of 10 and 16 C.P. can be obtained taking currents of not more than ·4 and ·64 ampere respectively, and with filaments stayed and sufficiently strong to allow of their being used with care in almost any ordinary position. Consumers having an alternating-current supply at any voltage can avail themselves of such lamps by installing transformers to convert to the desired pressure, and in nearly every case it will pay to do so.

Manufacturers have not been slow to grasp the situation, and at the present moment quite a brisk trade is being done in small transformers for converting to 100 volts or under.

There is no reason why the manufacture of these transformers should be confined to makers having a well-equipped workshop. They can be turned out quite well by anyone

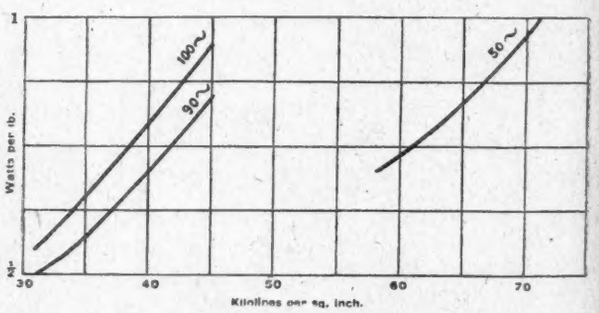


FIG. 1.—"STALLOY," 0·02 IN. THICK.

having a lathe and the usual bench tools, and in this article it is proposed to go into their design and to show how good results can be obtained by anyone having the tools mentioned. A certain acquaintance with transformers will be taken for granted.

The losses which occur in a transformer are due to the resistance of the copper windings and to electrical and magnetic effects in the iron core. The copper losses are equal to $C^2 R + c^2 r$ (the capitals representing primary and small letters secondary quantities), and, therefore, increase rapidly with the load.

The iron losses are due to eddy currents and to hysteresis, and are practically constant for all loads. Eddy currents can be reduced by using an iron of high electrical resistance, suitably laminated and insulated parallel to the flow of the magnetic flux.

Hysteresis is directly proportional to the periodicity for constant flux values and ordinary frequencies. It is to be noted, however, that it is not proportional to the flux for constant periodicity.

It is usual to combine the two iron losses, and the result plotted in the form of curves for different periodicities and flux values is shown in fig. 1.

These curves refer to a special brand of transformer iron known as "Stalloy," and supplied by Messrs. Joseph Sankey and Sons, of Bilston. So far as the writer is aware, this represents the highest degree of perfection yet attained in the manufacture of iron for magnetic purposes.

When a given E.M.F. is applied to the terminals of a

transformer, a back E.M.F. is set up which may be represented by the equation—

$$E = 4{\cdot}44\, n\, t\, F\, 10^{-8} \quad \ldots \quad (1)$$

where E = mean effective E.M.F.

$4{\cdot}44 = \sqrt{\text{mean}^2}$ of a sine wave through one alternation.

n = the frequency.

t = the number of turns in series in the coil being considered.

F = the total core flux.

10^{-8} = a coefficient used to reduce from the C.G.S. unit to the practical unit of E.M.F.

This holds good for both primary and secondary windings, and it is therefore evident that with a flux common to both, the relative E.M.F.'s will vary in proportion to the number of turns. It is also evident that the factors in the equation may be varied to any extent while keeping the E.M.F. at the same value.

The back E.M.F. set up in the primary coil will be less than the applied E.M.F. by an amount which is just sufficient to force the necessary magnetising current through the coil. This current should be as small as possible since it represents a dead loss.

The E.M.F. set up in the secondary coil will have an instantaneous polarity similar to that of the back E.M.F. in the primary, consequently, if a current be taken from it, it will circulate in a direction tending to demagnetise the core. This demagnetising action, although necessary, is, at the same time, highly objectionable, as it distorts the magnetic flux and causes some of it to flow in a path other than the one it is intended to take. The primary will respond by allowing an additional current to pass, which will have a value inversely proportional to the ratio of the number of turns in the two coils. Therefore, if the number of turns in the two coils are alike, the extra current flowing in the primary coil will be exactly equal to that flowing in the secondary.

If the windings were each designed to carry 10 amperes at 100 volts (neglecting for the moment the value of the magnetising current), the arrangement would be a one to one transformer of 1 KW. capacity. If we now join the two coils in series, so that their windings are in the same direction in effect on the core, we can connect the two extreme

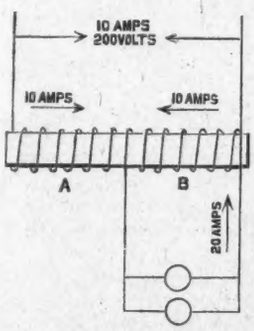


FIG. 2.

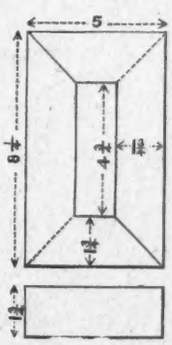


FIG. 3.

terminals across 200 volts since we have doubled the number of turns, the flux remaining exactly the same as before. Such an arrangement, called an auto-transformer or compensator, has the important advantage over a transformer with separate windings, that it can be used to deal with a load of 2 KW. at 100 volts, or it can be used to deal with an out-of-balance current of 2 KW. on either side of a three-wire system having 100 volts between neutral and outers.

This will be better understood by a reference to fig. 2, where the two windings are shown connected in series, and from between the junction and one of the other terminals a supply of 20 amperes at 100 volts is being given. Only 10 amperes of this, however, are being generated by transformer action in coil B. The other 10 amperes are made up by the primary current flowing through coil A, which leaves the winding at the junction and flows through the lamp load on the B side, on its way to the opposite main. The currents flowing in the different circuits (magnetising current neglected) are as shown.

From this it will be seen that the windings of a one to one auto-transformer need only be made of half the section that would be required for a transformer with separate coils, and the iron core can be correspondingly reduced. We can extend the principle by sub-dividing the windings into any number of sections, but the efficiency is obviously a maximum when the ratios are one to one or the equivalent.

We will now consider an actual design.

Let it be required to design an auto-transformer to supply 35 Osram lamps of 32 C.P. at 100 volts, primary volts 200, periodicity = 50.

The current at 100 volts will be about 12 amperes.

Let the core be assumed to be of "Stalloy" stampings ·02 in. thick and of the dimensions shown in fig. 3.

The windings will, of course, be placed on the two longer limbs.

The gross area of the magnetic circuit is $1{\cdot}75 \times 1{\cdot}75 = 3{\cdot}0625$ sq. in. Allowing 15 per cent. of this for insulation between the plates and for rounding off at the corners gives a net sectional area of $3{\cdot}0625 \times {\cdot}85 = 2{\cdot}6$ sq. in.

The allowable flux density depends upon the periodicity, and for a small transformer like this working at 50 periods, it will be quite within the limit if we take it at 64,500 lines per sq. in. This multiplied by 2·6 gives a total flux of 167·7 kilolines.

The iron measures $19{\cdot}5 \times 1{\cdot}75 \times 1{\cdot}75 \times {\cdot}85 = 50{\cdot}75$ cb. in.

A cubic inch of transformer iron = ·28 lb., so the weight is $50{\cdot}75 \times {\cdot}28 = 14{\cdot}21$ lb.

From fig. 1 it is found that at the density employed, the loss is ·83 watt per lb., therefore the total iron loss is $14{\cdot}21 \times {\cdot}83 = 11{\cdot}79$ watts or 11·8. The current at 200 volts to make up this loss is $11{\cdot}8 \div 200 = {\cdot}059$ ampere.

As there are to be two coils for 100 volts each, it will be sufficient to calculate the number of turns for one and make the other like it. From equation (1) we get—

$$100 \text{ volts} = 4{\cdot}44 \times 50 \times t \times 167{\cdot}7 \text{ kilolines} \times 10^{-8}.$$

Therefore, the number of turns is given by—

$$t = \frac{\text{volts} \times 10^{8}}{4{\cdot}44 \times n \times F} \quad \ldots \quad \ldots \quad (2)$$

$$\frac{100 \times 10^{8}}{4{\cdot}44 \times 50 \times 167{\cdot}7 \text{ kilolines}} = 265{\cdot}9 \text{ or } 266 \text{ turns.}$$

The current at full load will be a little over 6 amperes, so a No. 14 gauge wire will be used. No. 14 S.W.G. d.c.c. wire has a diameter of ·094 in., so will go about 10·6 turns per inch. The available winding space is $4{\cdot}75 \times {\cdot}75$ in., so the 266 turns can easily be got in in the six layers after every allowance has been made for insulation.

The length of an inside turn is 7 in., that of an outside about 11·85, and the mean length 9·42 in. As there are 532 turns in all, the total length after allowing for end connections is 419 ft.

The weight of this wire is just over 8 lb. and the resistance at 60° F. = ·674 ohm.

The current required for the iron is ·059 amperes, so the watts taken at no load would be $11{\cdot}8 + {\cdot}059 \times {\cdot}059 \times {\cdot}674 = 11{\cdot}802$ if the transformer had a power-factor of 1. The actual power-factor will be lower than this, depending upon the permeability of the magnetic circuit, and this will obviously vary with the way the joints are arranged, and the flux density at them. The better the joints are made, the better will be the power-factor. If we assume the power-factor to be as low as ·6, and there is no reason why it should not be made higher than this, the no-load losses of the transformer just worked out would only be increased to 11·806; so that for such small transformers as this if we construct the magnetic circuit as well as possible, and have a low resistance in the primary, sufficient accuracy will be obtained if we consider the no-load losses as being simply those due to the iron. At the same time the question of power-factor must not be dismissed as of no importance; it would never do to have the supply mains of a central station loaded up with the wattless current from a number of small badly-designed transformers.

The next point is to work out the drop in volts at full

load. This will be due to two causes, the resistance of the windings, and to some of the magnetic flux leaking from the core and not passing through the secondary winding owing to the opposing action of the current which is circulating in a direction contrary to that in the primary. This leakage cannot be prevented, but its bad effect can be largely annulled by sub-dividing and sandwiching the coils as much as possible.

The resistance of the copper has been worked out at a temperature of 60° F., and for each degree increase there will be an increase in resistance of ·238 per cent. The windings will present a large cooling surface and have been rated at a fairly low current density, so that the increase in temperature should not be much. Taking it at 100° F. gives the resistance at ·738 ohm, and as the current through the windings at full load will be 6·184 amperes, the drop in volts will be 6·184 × ·738 = 4·56, or just under 2¼ per cent. + that due to magnetic leakage, which cannot be accurately calculated.

This drop in volts at full load could be compensated by arranging to have a slightly higher voltage at no load, as by including some of the turns meant for the primary in the secondary winding. This completes the set of calculations. The actual arrangement of the core and windings will be dealt with later.

The next design will be for a transformer to supply 300 watts and capable of lighting 18 Osram lamps of 16 c.p. at 25 volts. Primary voltage = 110. Periodicity = 90.

By using a double secondary winding and arranging to have half the lamps on each coil as in a three-wire system, we can use the auto-principle for this design also, and therefore economise in material.

It is not necessary that the loads on the two sides should always be balanced, but merely that they should be approximately balanced, and the best results will be obtained when they are.

The core will be of the same general shape as the last, but it will be only 1·375 in. wide and thick at the limbs and yoke; the hole being 3½ in. long by 1½ in. wide.

Section through core 1·375 × 1·375 × ·85 = 1·6 sq. in.

For the higher periodicity of 90 a much lower flux density must be used, and this will be taken at approximately 41·93 kilolines. This multiplied by 1·6 gives a total flux of 67·09 kilolines.

$$\text{Number of turns } \frac{110 \times 10^8}{4{\cdot}44 \times 90 \times 61{\cdot}92 \text{ kilolines.}} = 410.$$

Volume of core = 17·81 cb. in.

17·81 × ·28 = 4·98 lb., and this multiplied by the watts lost, ·76 at the density employed, gives 3·684 as about the no-load loss in watts.

With the full load balanced on the two secondary windings the current through the coils would be 3 amperes, but if one winding should be lightly loaded while the other is at full load, there will be more than 3 amperes to be carried by the fully-loaded side, and for this reason more copper will be required in proportion in this design than in the last. However, if we use a No. 16 wire throughout it should meet the case very well. This wire will go 12·8 turns per inch, so that 205 turns per limb will easily go in in five layers of 41 turns each.

The length of a mean turn is 7·16 in., so the total length of copper will be about 246 ft., and the resistance, cold, ·619 ohm. The weight is just over 3 lb. The resistance hot will be ·675 ohm, and the drop in volts due to this = 2 per cent. Of course, it is understood that the number of turns in the 25-volt windings is as 25 to 110.

The next design is for a transformer with separate windings, capable of supplying 20 amperes at 25 volts, or just enough for 32 Osram lamps of 16 c.p. Primary winding suitable for either 100 or 200 volts. Periodicity = 100.

Using the same sized core plates as in the first design, and with a density of 38·7 kilolines, the core should be 1·4 in. thick. Where there is a considerable difference in the voltage of two windings it is better to calculate the low voltage one first. From equation *(b)* we get the number as—

$$\frac{25 \times 10^8}{4{\cdot}44 \times 100 \times 80{\cdot}437 \text{ kilolines}} = 70.$$

This will consist of two strands of No. 12 in parallel.

Length of a mean turn = 8·9 in. Resistance of winding cold = ·0249 ohm. Resistance hot = ·0272 ohm. Weight = about 3½ lb. Primary turns = 560 of No. 17 S.W.G. Number of layers = 5.

Total length of primary winding = 417 ft. Resistance cold = 1·371 ohm. Resistance hot = 1·501 ohm. Total copper drop at full load = 4· per cent.

It would be well to put a few extra turns on the secondary to keep the volts up at full load, or a greater section of copper might be used with advantage.

For working at 100 volts the two primary coils are to be connected in parallel.

General Considerations.—The three designs given have been worked out for "core" type transformers, but there is no reason why the "shell" type should not be used. Indeed, for cases of three-wire balancing or distribution, as in the second design, a shell-type transformer might be more advisable, as it would be easier to balance magnetically. The arguments for and against the two types hardly apply to such small transformers, and either type may be made to give good results.

Some makers adopt a "core" type as in the above design, but introduce a machined joint at one of the yoke pieces. The plates for the U portion and the yoke are riveted up separately between stout outside plates and the magnetic circuit completed by the addition of the yoke piece, which is held by bolts coming from a clamp at the opposite end.

The joint faces are filed as flat as possible, and then ground to a true surface in a lathe by a disk faced with emery cloth.

This is a cheap and convenient construction, as standard cores can be made up by unskilled labour and the transformer quickly completed by the addition of former-wound coils to suit any particular voltage or periodicity. This is the only advantage, and the disadvantage is that, no matter how well the joint may be made, the magnetic reluctance and magnetising current will be higher, and consequently the power factor and efficiency lower than with a well-constructed interleaved style of joint.

Joints should always be made with as large an area as possible, so as to reduce the flux density in the inevitable air-gap. For this reason, the writer prefers to use a diagonal joint, as shown in fig. 3, consecutive plates breaking joint at opposite corners, as shown by the dotted and full lines. Half the stampings should be insulated on one side and half on the other; then, by turning consecutive layers over, there is always an insulated surface between the plates. Former-wound coils are used, and after the core has been assembled in them, the plates are held firmly together at the ends by small insulated bolts passing through holes stamped for the purpose. The same bolts can be used for carrying terminal plates and brackets for supporting the transformer.

It will only be found necessary to stock two or, at most, three sizes of core plates, as most ordinary small outputs can be met by varying the number of plates used. The core type of transformer is pecularly subject to magnetic unbalancing, and to avoid the bad effects of this the coils must be sub-divided and interconnected between the two limbs as much as possible.

Half the primary turns should be placed on one leg and half on the other. So, too, with the secondary, and, further, the secondary winding should be sandwiched between the primary layers if best results are to be obtained.

When windings have to be connected in parallel, care should be taken that they are at the same distance from the core, as if an outer coil is paralleled with an inner, apart from the question of them not being of the same resistance, they may be the seat of a parasitic current due to a leakage flux passing between the two windings.

When a core type transformer is required to give a three-wire secondary service, it is not sufficient to have the secondary winding on one leg in series with that on the other, the neutral tapped on to the junction, and the primary coils similarly in series. Such a disposition of coils may give perfect regulation as long as the loads on the two sides are equal. But if the load on one secondary is reduced, the back ampere-turns of the other distort the flux and cause some of it to return through air to the lightly loaded side.

The ampere-turns on the lightly loaded side being then sufficient to produce a flux greater than is required for the normal voltage of that side will cause the volts to rise above the proper value, while they will drop by a corresponding amount on the loaded side. This effect can be got over by dividing each side of the secondary system, and placing the halves one on either limb.

The sandwiching of coils may bring together layers between which there is a considerable difference of potential, so there must be a turn or so of some good insulating material, such as Empire cloth, between every layer.

It is a mistake to varnish each layer as it is wound on. The coil should be completed and then made sufficiently hot to expel all moisture before any insulating varnish is applied.

Half layers should be avoided, as they tend to concentrate the flux and to produce distortion.

A transformer designed for a certain periodicity should not be used on one much lower than that. Thus, a transformer intended for a periodicity of 100 would get hotter, might hum in an objectionable way, would regulate badly, and would have a lower power factor and efficiency if worked at the same voltage on 50 periods. On the other hand, a transformer designed for a low periodicity would work well, have lower losses, and have a better power factor and efficiency on a higher periodicity. A high flux density will tend to produce humming, especially in the higher periodicities.

PORCELAIN INSULATORS FOR 100,000 VOLTS.

For many years it has been customary to increase insulation by putting insulators in series, and the insulators in use to-day for very high pressures are generally made of several shells fastened together by means of cement or other material.

Two or three years ago, however, it was recognised by potters that the problem of manufacturing shells exceeding 13 in. in diameter became very serious, and made the expense of insulators of that diameter almost prohibitive; with the view of eliminating such large pieces of porcelain, several inventors have been at work, and it is now commonly accepted that an insulator of the underhung type must prove the final solution, not so much from an electrical standpoint as from that of cost.

The original idea was to build two or three standard line insulators in series, but this arrangement was found to be mechanically weak, though electrically giving very good results. In order to overcome this difficulty, Mr. Locke, of the Locke Insulator Manufacturing Co., of Victor, N.Y., evolved the method shown in fig. 1, which depicts an underhung insulator for 100,000 volts, whose electrical qualities will be approximately three times that of any single one of the insulators; but mechanically this is an arrangement which engineers would hesitate to adopt. The most objectionable feature of this design is its great expense, since, to obtain any considerable mechanical strength, the "T" iron must be made very heavy; this condition is also very likely to prove disastrous electrically, since the introduction of any considerable amount of iron between the portions of a series insulator would probably make an enormous condenser of it, and would cause the bulk of the strain to be thrown upon the insulator to which attachment was made directly with the line. The above features, together with its great length, seem to rule it out as a possible future 100,000-volt insulator.

For the same service of 100,000 volts the General Electric Co. is proposing the use of disk insulators made up as shown in fig. 2, the several sections being fastened together by means of four or five turns of ⅛-in. dia. stranded steel wire. It will be seen that this method calls for the drilling of two U-shaped intersecting holes in the porcelain, and of course demands that these holes shall not open one into the other, as to each shell a total pressure of some 60,000 volts must be applied.

This type of insulator has proved valuable in many ways, but it has the disadvantage that the metal loops between the sections compel it to act like several condensers in series, and in any series condenser the shock comes mainly upon the end plates; hence this type of insulator might, in the case of a line subject to surges and lightning strokes, prove itself incapable of standing the strain, since it would be impossible to interpose between the line wire and the first metal link more than one piece of porcelain—a condition which is absolutely necessary if strains of 60,000 volts or more are to fall upon it.

Work which has been done at the Locke insulator factory in the past year seems to indicate that insulators of the underhung type can be made which will withstand continuously very heavy strains both mechanically and electrically. Fig. 3 shows an underhung insulator which represents a considerable amount of work. The means of attachment consists merely of a metal strap and stirrup which has sufficient mechanical strength to resist 7,000 lb. pull—a value greatly in excess of anything which is met with upon modern transmission lines. It was found that the end shells of the insulator must be made strong enough to withstand the entire pressure of the line, and, in order to do this for a 100,000-volt line, it was necessary to interpose two pieces of porcelain, as shown in the figure. With this improvement the Locke Co. has been able to make a series insulator not over 5 ft. in length, and capable of being operated in the face of a heavy rain at 220,000 volts. The shells are simple, and the metal attachments inexpensive. Mechanically and electrically it is very strong, and no unusual procedure is involved at any point in its construction. As far as insulator manufacturers can guarantee, the makers guarantee this device good for 100,000 volts.

The agents for the United Kingdom and the Colonies for the Locke Insulator Manufacturing Co. are Messrs. Geipel & Lange, of Vulcan Works, St. Thomas's Street, London, S.E.

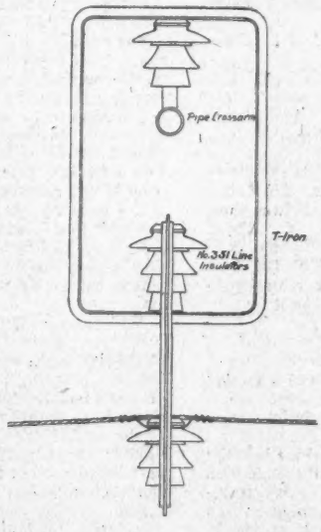


Fig. 1.

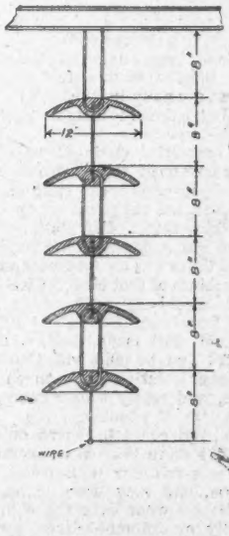


Fig. 2.

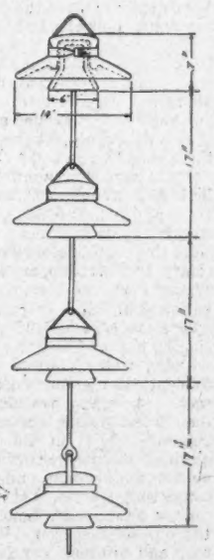


Fig. 3.

LEGAL.

Bournemouth Corporation v. Poole and District Electric Traction Co., Ltd.

The Master of the Rolls and Lords Justices Fletcher Moulton and Buckley on Thursday, January 23rd, heard the appeal of the defendants from the judgment of Mr. Justice Joyce.

Mr. Danckwerts, K.C., and Mr. Tomlin appeared for the company, and Mr. Hughes, K.C., and Mr. Geo. Lawrence for the Corporation.

Mr. Danckwerts said the question arose as to whether Mr. Justice Joyce had rightly decided that the company was to pay to the Corporation three sums—a deposit of £1,875, which had to be paid under the Light Railways Act, and which was returnable when the line was opened for traffic; a sum of £544 9s. 4d. due from sundry debtors to the company; and a sum of £1,410, cash in hand and at bankers. The company was formed to construct a light railway between Bournemouth and Poole in 1899, and it subsequently acquired an extension order and powers to construct another tramway to Christchurch. It also had running powers over the Bournemouth Corporation tramways. The Bournemouth Corporation also had sundry tramway undertakings, and they had powers to construct another line in respect of which they had to commence within a year of the date of the order. The company alleged that they had not done so, and an action was brought to restrain them from carrying the order out. The Chancery Judge found in favour of the Corporation, but his decision was reversed on appeal. The Corporation intended to appeal to the House of Lords, but the litigation was compromised by an agreement for the sale of the company's enterprises in Bournemouth to the Corporation, and it was in respect of this agreement that the present dispute arose. The Corporation was to pay £5,500 in cash

and a sum, which was fixed by arbitration at £100,000, as being the fair market value of the undertaking as a going concern. Mr. Justice Joyce had decided that the Corporation were, in addition, entitled to the three sums he had mentioned, but the appellants contended that they did not form part of the undertaking as defined in the agreement.

MR. HUGHES, K.C., supported Mr. Justice Joyce's judgment, and contended that the three sums were all included in the valuation of £100,000 which the Corporation had paid.

There was also a cross appeal by the Bournemouth Corporation in respect to two sums of £6,476 odd out of a bank loan of £7,000 and £2,570 for "sundry creditors," which the Judge below had allowed to the company.

THE MASTER OF THE ROLLS, in giving judgment, said the deposit had been returned to the depositors before the date appointed for the transfer of the undertaking, and he found nothing which gave the Corporation any claim to it. He found, if possible, still less ground for the second item for sums "due for sundry debtors to the company," because it was really an accountant's mode of apportioning sums which had been paid over a period partly extending beyond the appointed day. Every word he had said with regard to the deposit applied with equal force to the third item of cash in hand and balance at the bank. It was only part of the company's undertaking that was purchased, and there was no ground for the suggestion that any part of the cash in hand was acquired by the Corporation. As to the second appeal, the Corporation had undertaken to indemnify the company in regard to liabilities or engagements outstanding on the appointed day, and he saw no ground whatever for limiting it as the Corporation proposed.

The other Lords Justices agreed, and the company's appeal was, therefore, allowed, and the Corporation's appeal dismissed in both both cases, with costs.

HEATH AND OTHERS *v.* THE BRIGHTON CORPORATION.

(*Continued from page* 135.)

AT the hearing on Wednesday, January 22nd, his LORDSHIP said that it appeared from Prof. Wilson's evidence that the nuisance only arose when engines 3 and 5 were working. He was sure the Corporation desired to treat the plaintiffs with every consideration, and he suggested that it would be advisable for their experts to take special observations of the running of these particular engines. If something could be done to abate the nuisance plaintiffs would be satisfied.

MR. ASTBURY, K.C., said the Corporation were most anxious to do anything his Lordship suggested.

It was arranged that after Wednesday the case should be adjourned till Friday for inspection on Thursday of the running of the engines.

The REV. MR. ROBERTS, late Curate of St. Mary's, afterwards gave evidence that the noise from the engines interrupted the performance of his clerical duties.

MR. ASTBURY, K.C., in opening the defence, declared that the Corporation had exercised their statutory powers in a most reasonable manner, and had done everything possible to meet the plaintiffs. It was utterly impossible to detect any noise unless one knew that it existed and specially listened for it. He declared that if they could get the Judge down to Brighton for ten minutes there would be an end to this case.

MR. JAMES SWINBURNE, consulting engineer, was then examined by MR. YOUNGER, K.C., on behalf of the Corporation. He stated that on April 10th, 1907, he inspected the station. It was then working at its maximum load for that time of the year. There were three dynamotors working there. The station contained four rotary transformers, among other plant. Those were of the best type of modern design, and there was no looseness or vibration to be found in them. All machines of that class, in fact, most moving and some still electrical machines, made some humming or singing noise. The rotary transformers were, in the opinion of the witness, well designed and well made, and were on proper foundations. Witness could find no fault with the station in any way. A rotary transformer station was much more silent than a generating station, and rotary transformer stations were generally placed in the centre of populous areas. The noise was quite audible in the station, and could be heard outside; but the hum was not serious, and not more than was generally made by a converting station. He was familiar with many rotary transformer stations in London, and they were much bigger than the one at Brighton. Witness went over the church at Brighton, and listened carefully at different places, especially those indicated by Mr. Heath. The slight noise was certainly audible at different places in the church when all was otherwise quiet. It varied from place to place, but in no place was the noise such as to be a nuisance. The noise was audible when the church was quiet. At its worst it was a faint hum or buzz. It was a low musical note, a little higher than the lowest G on the manuals of the organ. The noise was completely drowned by anyone speaking, and by anyone passing in the street outside. The noise was not more excessive than a humming noise at the hotel he stayed at in Brighton, which was caused by wind in the chimney.

On Friday, MR. SWINBURNE, cross-examined by MR. HUGHES, K.C., for the plaintiffs, said he did not think fog would make any difference in the conduction of the sound, but wind would make a great difference. Barometric pressure did not make much difference. He did not know that anything had been done to the roof of the converter house to render it less transmittive of sound.

Deadening materials, such as felt, applied to the walls and roof might effect considerable reduction if the sound is air-carried?—Yes.

Asked if he thought the sound was earth carried or air-borne WITNESS said it was probably air and earth carried, but chiefly by the ground. It was exceedingly difficult to theorise about it. He agreed that the sound arose from vibration. The question of vibration was not satisfactorily solved.

There has been great difficulty with regard to that in generating stations?—Yes, more especially with reciprocating engines.

MR. SERGEANT, for the defendants, then examined witness as to the observations he had made on the previous day. MR. SWINBURNE said he went with Prof. Boys, and met Mr. Christie at the electricity works, and they all synchronised their watches. Mr. Christie remained at the works, and witness and Prof. Boys went to the church, arriving there just before 12.30. They had arranged with Mr. Christie that he should ring the changes on the machines, and try all possible combinations of them, and keep a record. They did not know in what order the machines were going to be put on. They did not know at what intervals the changes would take place, only that Mr. Christie was to allow each combination to run long enough to enable them to take proper observation without being interfered with by chance interruptions. Witness went on to give minute details as to the observations he had made in the church. These observations went to show that passing carts or trams, street cries, children playing, and similar external sounds, practically drowned the noise from the works. Witness agreed that the quiet combination of machines was Nos. 1, 2 and 3, and he disagreed with Prof. Wilson's theory that Nos. 1, 3 and 5 were the noisy combinations. He had not found anything to indicate that No. 5 was a specially noisy machine. He found that Nos. 1 and 2 were specially silent. Subsequently Mr. Christie, at the request of Prof. Boys and witness, ran any combination he chose; preferably the machines he thought likely to make the most noise, and opened and shut the doors of the works. Mr. Christie ran all the machines at once to get the maximum noise, but witness and Prof. Boys could not find any difference in the amount of noise. He did not agree with Prof. Wilson's view that the doors acted as reverberators. They could not possibly do that. There was nothing throughout the whole of his visit to the church on Thursday that would have been an annoyance to him if he had had to work under these conditions.

Cross-examined by MR. HUGHES, K.C.: If people tell you that when they have to be much in the church they find this continuous noise is a serious nuisance to them, do you think there is any reason to disbelieve them?—No; I do not. People vary very much. Witness went on to cite the case of his wife who, he said, could not sleep with a watch in her room.

Have you any reason to think that it is a serious inconvenience to a clergyman who has to carry on services there?—I have no doubt that it is a serious inconvenience, and probably an annoyance to him. It is an annoyance to him, because he has worked himself up into a certain state.

I suppose you find that an annoyance long continued does get on ordinary nerves?—Sometimes, yes.

You have got to have an extremely well-balanced nervous system not to get a continuous annoyance on your nerves?—I don't think so. Some people who sleep with a clock in their room are awakened when the clock stops.

But supposing a thing does annoy you even slightly, and is long continued, does it not necessarily get on your nerves and prove a serious annoyance?—It is a matter of your own will-power entirely. I do not think these people have used their will power. They have tried to magnify the noise.

You have no reason to think they purposely did so?—Not with any malicious intent.

Re-examined by MR. YOUNGER, K.C., WITNESS said his view was that a very ordinary exercise of will power would prevent a person constantly engaged in this church from experiencing any annoyance.

MR. ARTHUR WRIGHT, consulting engineer to the Brighton Corporation, examined, stated that, in his opinion, the site of the electricity works was well selected, having regard to the fact that the neighbourhood was an industrial one containing a number of small factories and works. He considered that the noise of steam from the old steam plant, and the constant coming and going of the coal carts, which went on formerly, must have been a far greater nuisance than the hum heard in the church. Witness mentioned some of the attempts that had already been made by the Corporation to lessen the noise complained of, and mentioned that certain of the machines had been shifted and put on a new foundation of felt and lead to deaden vibration. The cost of that would be nearly £100. He noticed a distinct improvement from the alteration. The sound he had noticed during recent visits to the church was less than that of a blue-bottle humming in a 15-ft. room. If one did not have his attention called to it, he did not think, except in one particular place in the chancel, one would hear the noise. It would not be an annoyance to him. The North Road converter house was a necessary part of the Corporation electricity supply system, and he considered it would be impossible to do without a converter station with the Southwick scheme. The noise of a motor-bus, or the ordinary noise generally going on, in North Road or Church Street, was very much greater as a noise than any noise he could hear in the church.

ALDERMAN HENRY GERVIS said he was Mayor of Brighton last year, and had attended service at the church on three separate occasions. It was only by the most strained attention that he could hear the noise. He thought it was most trumpery. He could hear nothing at all while singing and reading was going on.

COUNCILLOR HENRY GERMAN spoke to receiving complaints from

Mr. Heath about the noise, and said he went to church on several occasions when it was empty and quiet. His experience was the same as that of Alderman Gervis, and he saw no ground for complaint.

PROF. BOYS said he had made a special study of acoustics. He had been consulted by the Brighton Corporation, and visited the church on June 3rd, but was surprised at not being able to hear a sound anywhere. His attention was directed to a spot in the chancel, when he noticed a faint sound. It was so small that it ought not properly to be called a noise. He could not understand it being called a disturbing nuisance. Witness corroborated Mr. Swinburne's observations on the experiments of the previous day.

Cross-examined by MR. HUGHES, K.C., WITNESS said he at first thought the noise was air-borne, but now he had come to the conclusion that it was carried through the earth. He had arrived at this conclusion by pressing his forehead rather hard against the masonry of the church when he could feel a faint vibration. Assuming that it came through the earth, the only thing that could be done to reduce the vibration, he thought, would be an elastic support under the machines. There was felt under Nos. 1 and 5 machines, but he did not think it could be very elastic with such weight upon it. If the sound was air-borne, he admitted that enclosing the machinery might lessen the noise, but that was only assuming that he was wrong in thinking the noise was carried by the ground.

A number of tradespeople in the district gave evidence that a nuisance existed in the old days of the steam plant in North Road, and they generally agreed that since that had been stopped, they had no complaint to make.

MR. JOHN CHRISTIE, electrical and mechanical engineer and manager of the Brighton Corporation's electrical undertaking, said the complaints about the old steam plant at North Road were chiefly about smoke, smuts, and steam condensed from the cooling towers and deposited on peoples' clothes in backyards. Since the generating station had been removed to Southwick, there had been no more of these complaints. The machines installed in the converter house were as silent running as it was possible to get such machines. Witness detailed the steps the Corporation had already taken to meet Mr. Heath's complaint. No. 1 machine, which was now No. 2, had been standing over a culvert, and they had it shifted and put on a felt bed. They also had doors put up, and hung up tarpaulins inside the building. They also thought a ventilating fan helped towards the noise, and this was accordingly stopped entirely. He did not think that anything further could be done by way of minimising the sound complained of. He had been in the church 70 or 80 times, and had listened for the noise in places pointed out to him by Mr. Heath. As a result of his observations, he would describe the sound as a very low musical humming note, which varied in intensity from time to time; but even at its maximum it would not disturb him in the slightest degree. He could not hear it unless he listened most attentively for it, and the church had to be in absolute silence. The passing of a tram entirely drowned it.

Cross-examined: WITNESS said he thought the cause of the noise was magnetic vibration. He did not know of any other type of machine that would do the work of Brighton with less noise. The big rotaries A and B were of 1,500 KW. capacity and did a large portion of the work at night. They revolved at comparatively low speed compared with the other machines, and, therefore, made relatively less noise.

The case was continued on Saturday, when MR. TALBOT, town clerk of Brighton, said the Corporation had made every effort to stop any noise that might be heard in the church.

PROF. BOYS, recalled, said he believed the noise was a ground sound, and suggested that they should place the church columns on elastic supports. This might afford a remedy, but he could not guarantee that it would be an absolute cure.

This concluded the evidence, and the case was adjourned till Thursday (yesterday), when his Lordship was to hear speeches by counsel.

ATTORNEY-GENERAL *v.* FLEETWOOD URBAN DISTRICT COUNCIL.

AT the Lancashire Chancery Court, at Liverpool, on the 23rd inst., Vice-Chancellor Leigh Clare had this matter before him, the action being taken with a view of restraining the Council from spending the ratepayers' money in a case in which they were not parties. It transpired that the three Councils of Thornton, Bisham, and Fleetwood, had joined in the Thornton Council's action to support a claim to rate the Blackpool and Fleetwood Electric Tramways Co. as a tramway, the company contending that as its line was virtually a railway, it ought only to be rated as such.

MR. GRANT, for the Fleetwood Council, admitted that the expenditure was technically *ultra vires*, but as this was the cheapest form of winning or losing the case, he argued that it was in the interests of the ratepayers, and ought to be allowed to go forward, the expenditure being submitted in due course to the equitable jurisdiction of the L.G.B. auditor. The Fleetwood Council, although it would have to take up the case alone if it had to go to another court—the other two Councils, which were much smaller, not being willing to risk further litigation—was determined to go, if need be, to the House of Lords. The refusal of the tramways company to pay the higher rate, meant a loss to Fleetwood of a 1d. rate (£255) for each future year.

His HONOUR (without calling upon Mr. Mansfield, counsel for the plaintiff) said he could not permit a Council to do that which was admittedly illegal. Hence, he must grant an injunction to restrain any further expenditure in regard to an action in which the Council was not directly concerned. At the same time, he sympathised with the Fleetwood Council, as it was not really fighting an individual ratepayer, but the tramways company.

MR. GRANT tried in vain to induce his Honour to relax his decision, on the ground that the best interests of the ratepayers were being served, but at length he had to be content with a declaration that the Vice-Chancellor had said nothing with regard to the expenditure already incurred in this matter.

THE LATE SIR JOHN PENDER AND THE SUPPLY OF ELECTRICITY TO ROME.

(*Concluded from page* 135.)

WHEN the case was resumed on Wednesday, January 22nd, MR. HORRIDGE, K.C., M.P., continued his opening statement. He went at length into the various negotiations which took place from 1899 onwards in connection with the scheme. He said plaintiffs had spent large sums of money in obtaining concessions for water-power from the Cardinal Prince Hohenlohe. Sir John Pender and Mr. Jabez Spencer Balfour got so far as the preparation of the prospectus of the Italian General Works Electrical Enterprise Co. That draft prospectus set forth in detail the various concessions for water-power which the plaintiffs had obtained from the Cardinal Prince Hohenlohe and the House of Austria. They said they were entitled to £50,000 as soon as they satisfied the promoters of the company that they could get the concessions. They did everything they possibly could, and the only difficulty in carrying out the scheme appeared to have arisen through the tightness of the money market, owing to the Baring crash. Plaintiff got conveyances of the property at Tivoli drafted, and went to very great expense. This was a great and magnificent scheme for lighting Rome by electricity, but, unfortunately, it was ruined by the scarcity of money at the time, caused by the Argentine revolution and the Baring crisis. In his closing, Counsel mentioned that there had been by agreement a waiver of the Statute of Limitations in order to suit the convenience of both parties. He asked the jury to give his clients substantial damages.

MR. GIROLAMO TADDEI, one of the plaintiffs, stated that he was an engineer and had carried out many electrical and other works in Italy. He visited Sir John Pender in London, and that gentleman was most enthusiastic about this scheme. He had many meetings and consultations in London—at Winchester House—with Sir John Pender, Mr. Jabez S. Balfour, and others. Witness gave them all the explanations they required as to the scheme, and everybody was satisfied. He and his partner had spent about £20,000 over the scheme altogether.

Cross-examined by MR. RUFUS ISAACS: His partner lived in Turin, and they had had many operations together. He got a number of concessions for lighting Italian towns, and mortgaged several of them to Sir John Pender for £10,000. Sir John Pender got judgment against him in 1898 for £12,000, but he had nothing on which that could be realised. He had concessions for lighting Rome and Tivoli.

The case was again resumed on Thursday, January 23rd, when GIROLAMO TADDEI was again cross-examined by SIR EDWARD CARSON.

On Monday, January 27th, MR. MACKENZIE was cross-examined by MR. RUFUS ISAACS. Witness was called out of the box by Sir Edward Carson, who after consulting with Mr. Horridge, K.C., for the plaintiffs, said a settlement of the case was arrived at.

MR. HORRIDGE said it was a long and difficult case, and Sir Edward Carson and he had arrived at terms which were satisfactory to his clients. He thought there was no occasion to say more, but a Judge's order would be taken, if necessary.

SIR EDWARD CARSON, for the defendants, said he was glad the matter had been arranged. If the case had gone on, there must have been a very protracted litigation. He thought the parties had met each other reasonably, and they were on each side satisfied at a happy termination.

MR. JUSTICE GRANTHAM said he had no doubt that, after what counsel had stated, something had been done to get out of the difficulty and to assist the plaintiffs.

The case was then accordingly withdrawn from the jury.

W. S. ATKINS & Co. *v.* FOULKES.

IN the Lord Mayor's Court last week, before Sir F. Bosanquet, K.C. (the Common Serjeant), and a jury, plaintiffs, a firm of electrical engineers and fitters, sued Mr. H. C. Foulkes, described as a speculative builder, of Finsbury Pavement House, Finsbury Pavement, E.C., to recover the sum of £27 12s. 7d., balance of the price of certain electrical work done for the defendant at blocks of houses, or flats, being erected by him at East Twickenham.

The plaintiffs' case was that in January, 1907, an interview took place between Mr. W. S. Atkins, the working partner in the plaintiff firm, and the defendant, with regard to the installation of electric bells upon house property which the defendant was erecting at Twickenham. The plaintiffs had done similar work for the defendant on previous occasions, but at the date in question, the defendant suggested that he might supply the plaintiffs with the material from his builders, Messrs. Young & Marten, of Brentford, and so get better terms than the plaintiffs. This was agreed to on behalf of the plaintiffs, and the terms eventually arranged were that they (plaintiffs) should install electric bells in flats erected on the Cambridge House Estate, complete with fittings, at

5s. 6d. "per push point." For bare wiring the price was to be 2s. 6d. per push point, materials 2s. 4½d., and fixing the fittings 7½d. It was part of the arrangement that the defendant should advance one shilling per push point as the work proceeded, the balance being paid upon completion of the installation. Mr. Atkins, in his evidence, said that as the work proceeded they obtained the material from the defendant's merchants, Messrs. Young & Marten. The work was delayed through the defendant not supplying the necessary material, and eventually some of the work had to be left in an uncompleted condition. A bill for the full sum chargeable was sent in to the defendant, but subsequently an account for the sum now sued for, which was for the price of the work actually done, was sent in. A demand was made for payment, but the account had not been paid.

For the defence it was said that the plaintiffs had received advances on account of the wiring work they had done, and those advances, together with a sum which had been paid to the plaintiffs' solicitor, were sufficient to satisfy the plaintiffs' account under the terms of their bargain. The balance of the price was to be paid upon completion of the installation, and in many cases the installation had not been completed.

The Common Serjeant said it was for the jury to say what the bargain was between the parties, and whose fault it was that the work was not proceeded with in a reasonable time.

The jury found a verdict for the plaintiffs, but the question as to the amount for which judgment should be entered was referred to the Registrar of the Court.

Isenthal & Co. *v.* Brown, Geary & Aarons.

In the City of London Court, on Monday, before Judge Rentoul, K.C., an action was brought by Messrs. Isenthal & Co., electrical engineers, 85, Mortimer Street, W., to recover the sum of £35 for certain electrical apparatus supplied to the defendants, Mr. F. E. Brown, 83, Station Street, Birmingham, and Mr. W. C. Geary, 71, Queen Victoria Street, and Mr. L. J. Aarons, Villa Road, Handsworth, Staffs., which was exhibited by them at an electrical exhibition in Birmingham last year. Mr. Harold McKenna was counsel for the plaintiffs, and Mr. Harry Lewis for Mr. Brown. The other two defendants did not appear. Plaintiff said that Mr. Brown wrote to him and said that he and some friends were forming a syndicate to exhibit some electrical goods at the Birmingham exhibition last year. Aarons and Geary said they were employed by the General Electric Co., Ltd., Queen Victoria Street; but as their company was also exhibiting at Birmingham they did not want their own names to appear more than necessary. The three defendants ordered certain electrical apparatus and it was exhibited.

Mr. Brown, in his evidence, said he was only the secretary of the syndicate at a salary of £2 a week. As a fact, the syndicate was never actually formed; but he never pledged his own liability to the plaintiffs. It was true he asked the plaintiffs for a commission, but that was only to be sure that the others were getting absolutely bedrock prices.

Judge Rentoul said that all the defendants were liable to the plaintiffs. He had some doubt at first about Mr. Brown's liability; but he had mixed himself up in the matter. Judgment for the plaintiffs for the amount claimed, with costs.

PARLIAMENTARY.

Highgate Hill Tramways Bill.

On January 22nd, Mr. Campion, the Examiner for Proof of Compliance with Standing Orders, considered the Bill promoted by the Highgate Hill Tramways Co. for the electrification of the cable line there, when a point of some interest to tramway promoters was decided.

Mr. Pritt said that the one broad point which he had to deal with, was whether the Bill was a first-class or a second-class Bill. The Bill was one to empower the Highgate Hill Tramways Co. to electrify the existing lines. By an Order in 1882, that company was empowered to construct and maintain certain tramways on a gauge of 3 ft. 6 in., and the greater portion of the tramway had been constructed, and was worked as a cable tramway. About half the line was in the Borough of Islington; it then passed for a short distance through Hornsey, and of the remainder of the line, one side was in St. Pancras, and the other in Hornsey. The London County Council was, therefore, the local authority for the greater portion of the line. By Clause 3 of the Bill now before the Examiner, the promoters took power to alter the gauge from 3 ft. 6 in. to 4 ft. 8½ in., and to remove all or some of the existing rails. His main allegation was that there was a power to construct a new tramway, and if there was any doubt as to that, he alleged that it was varying, extending or enlarging a tramway. It was a question which had never been formally discussed before the Examiner, as to whether an increase in the gauge of a tramway constituted a Bill a second-class Bill or not.

Mr. Lees said there was the City of Birmingham Tramway Bill, which was not an opposed Bill, but the matter was discussed, and it was decided that the Bill was not a second-class Bill.

Mr. Pritt argued that the widening of the gauge did constitute the Bill a second-class Bill. Parliament had been very particular in its requirements as to notices being given, the deposit of plans, &c., under the Tramways Act. When people came to Parliament for a tramway they were asking for a very great concession from the public, and it was obviously desirable that the public and the local authority and road authorities, and particularly the residents and frontagers, should know what was contemplated when a Bill was deposited in Parliament. In this case the tramway was 3 ft. 6 in., and the company wanted to alter it to 4 ft. 8½ in., and, of course, to take up more of the roadway, but in the Bill there was nothing to prescribe the manner in which the work was to be carried out. No notices to the frontagers had been given, and surely the public were entitled to have some definite scheme before them as to what was to be done.

Mr. Lees, for the promoters, said he could produce a Bill absolutely parallel with his own, and that was the Wolverhampton Tramways Act of 1899, which empowered the Wolverhampton Tramways Co. to alter the gauge of certain of their tramways.

Mr. Campion asked if this was an opposed Bill.

Mr. Lees said it was not an opposed Bill, but there could be no mistake as to what was meant. In the case of the City of Birmingham Tramways Bill in 1901, the proposal was to reconstruct 26 miles of tramway. No memorial was deposited against the Bill, but it was felt that it afforded a convenient opportunity for discussing before the Examiners whether the electrification of existing tramways required the deposit of plans and estimates, and so on. A number of Parliamentary agents did discuss the matter before Mr. Campion and Mr. Jeune, and it was decided that the Birmingham Tramways Bill was not a second-class Bill, and therefore did not require street notices or plans or deposits, and all the expensive machinery which, in the case of the Birmingham Bill, would have cost £5,000. Under the Tramways Act of 1870 it was stated that if the gauge was not specified it should be 4 ft. 8½ in., but for many years now the orders had been passed naming the gauge or leaving it to the Board of Trade. All the Board of Trade orders contained that power, and, as a matter of fact, if the Highgate Hill Tramways Co. had got their Act at a later date the question now contested would not have come out. He attached great importance to Clause 18 of the Model Bill, which gave the Board of Trade power to authorise the doubling of a single line from end to end. That clause did not allow the tramlines to come within 9 ft. 6 in. of the kerb without the consent of a certain proportion of the frontagers, but in his own Bill he had provided that he should not come nearer than 9 ft. 6 in. to the kerb without the consent of every frontager. As a matter of fact, he did not want to come within 9 ft. 6 in. of the kerb. In 1898 the Portsmouth Corporation obtained a Bill enabling them at some future time to purchase the existing tramways of the company, and in their Act they included the power to double the lines. There it would be seen power was given the Corporation to double the lines even before they purchased them, and there was no suggestion of the deposit of plans or anything else. By the Tynemouth District Tramways Act of 1879 no gauge was specified. Three years afterwards the company went to the Board of Trade for an order for additional tramways, and Clause 8 authorised the alteration of the gauge from 4 ft. 8 in. to 3 ft. As a matter of fact, the company constructed the tramways on a 3 ft. 6 in. gauge, and then came to Parliament for power to do it. In 1905 the Wigan Corporation got power to alter their gauge, and in 1901 the London County Council took power to double the whole of their lines. It was a very wide power, as it was not confined to the tramways in the Bill. In conclusion, Mr. Lees mentioned the cases of the Gravesend and Rosherville Orders of 1881 and 1884, and of Luton in 1905, which were Board of Trade Orders, and allowed alteration of the gauge with no deposit of plans.

Mr. Campion said the only question really before him was whether the electrification of a horse tramway was a second-class work, and that had been to a large extent anticipated by what happened before the Examiners in the case of the City of Birmingham Tramways in 1901. That was the only case in which any principle had been laid down by the Examiners in regard to that point.

Mr. Pritt pointed out that his allegation was as to the widening.

Mr. Campion said it was impossible for him to hold that the electrification of a horse tramway constituted a second-class work. So far as the other powers were concerned of doubling a tramline or altering the gauge, the larger power of doubling could only be sanctioned under the Board of Trade, and the rights of the frontagers were safeguarded under Sub-Sec. 3. He did not consider that the alteration of gauge taken alone was enough to constitute a second-class work.

Standing Orders.—On January 22nd the following Bills passed standing orders:—Nottinghamshire and Derbyshire Tramways; Macclesfield and District Tramways; London (Westminster and Kensington) Electric Supply Cos.; Finchley U.D.C.; Great Northern, Piccadilly and Brompton Railway; Dublin and Central Ireland Electric Power; North-East London Railway; Croydon and District Tramways; and Wolverhampton Corporation.

Lower Thames (Grays) Docks.—Owing to lateness in making the necessary money deposit, the Examiner found on Monday that this Bill, which includes power to generate and sell electric energy, had not complied with standing orders. It was explained that the deposit had been made, and the matter will come before the Standing Orders Committee.

Scotch Orders.—The necessary standing orders have been found to be complied with in the case of the Ayr Corporation Tramways, Lanarkshire Tramways, Loch Leven Water-Powers, and the Wishaw Burgh Electricity.

Erith Tramways Bill.—This Bill should have been before the Examiners on Wednesday for proof of compliance with standing orders, but was marked "No appearance." The object of the Bill was to amend the Erith Tramways and Improvement Act, 1903, and the London County Council (Tramways and Improvements) Act, 1904, and to empower the U.D.C. of Erith to run over and use a tramway of the L.C.C. and the tramways of the U.D.C. of Bexley.

Bolton Corporation Bill.—As there was no appearance before the Examiners on January 22nd, when this Bill should have come up for proof of compliance with standing orders, it is presumably dead. Amongst the powers sought was a revival of authority to construct a tramway authorised by the Act of 1897, and to borrow £6,100 in respect of that work.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"S. E. C." writes:—"Can a supply be legally demanded at power rates for a direct-current transformer to be used for accumulator charging, the latter to be used only to supply the lights in the building? 230 volts is the pressure at present, and it is desired to use Osram, or any other low voltage lamp, taking 2 watts or under per C.P. The motor-generators could be run direct on to the lights.

"Our desire is to find some cheaper method of lighting the building, and we should like to carry it out in this way, in preference to a steam or gas plant."

*** This query has been put before in another form. What it appears to come to is this: Can a consumer demand a supply of electricity at power rates, when his real object is to drive a motor-generator for the purpose of supplying lamps? It appears that to use a supply of electricity at power rates for such a purpose would be regarded by the Courts as a device for evading the Electric Lighting Acts. Of course, this view is put forward without any authority to support it, as there has not been any actual decision upon the question.

CORRESPONDENCE.

***Letters received by us after* 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wireless Telegraphy.

Mr. Fessenden, in his letter to the ELECTRICAL REVIEW of January 17th, evades the real point at issue.

In his communication to your issue of November 22nd he said that the Marconi system as at present installed for communication across the Atlantic was not capable of commercial operation.

I pointed out in my letter of November 29th that stations were "certainly capable of commercial operation," which were transmitting words in bulk, and that the commercial efficiency of the stations was proved not merely by the direct testimony of newspapers using the service, but by the long despatches themselves, transmitted by wireless and published in the Press.

The *New York Times* has published, and continues to publish, many columns of European news transmitted by the Marconi system from Ireland direct to Canada. This in itself is proof that the stations are capable of commercial operation and are being worked commercially. In commenting editorially on the service, the *New York Times*, in succeeding issues, has made the following statements, which Mr. Fessenden has no doubt had the pleasure of reading:—

> Our wireless despatches from Europe come to us in excellent shape, *comparing favourably* with those by cable. Despatches . . . . by the Marconi wireless service from Clifden, Ireland . . . . filled a whole page. They provided such a test of the speed, efficiency and rapidity of the new service as it had not previously been subjected to, and proved conclusively that wireless telegraphy for long messages has passed the experimental stage, and is an established scientific and commercial fact. The Marconi system is now a lively and formidable rival of the ocean service, and the rivalry will grow.
>
> The *Sunday Times* received foreign news despatches which filled more than a page. Our Sunday record of a full page of Marconi was broken . . . Only a few months ago we were all saying that the problems of wireless telegraphy were still unsolved. Marconi, the greatest inventor of this hour, has proved that the most difficult of them have been solved with brilliant success.
>
> The wireless trans-Atlantic service of Marconi continues to "make good." Another whole page of wireless despatches in the *Sunday Times* was eloquent testimony of its efficiency. Some of the best of our rich and extensive budget of special foreign news . . . was forwarded from Clifden, Ireland, across the wide ocean to Glace Bay without the help of wires.
>
> Prof. Pupin . . . says: "As a matter of fact, wireless companies will never be certain that they can transmit messages. Changes in atmospheric conditions alone are an almost unconquerable obstacle."
>
> We advise Prof. Pupin to read to-morrow's *New York Sunday Times*. For weeks past it has in each issue spread before its readers upwards of 4,000 words of Marconi trans-Atlantic wireless news, the authenticity, clearness and accuracy of which have never been, and could not be, questioned. During all this time changes in atmospheric conditions, which, if the accounts of storm-harassed voyagers are an index, have been pronounced, have not seemed to Mr. Marconi or to the *Times* the "almost unconquerable obstacle" which the learned theorist of Morningside Heights so dejectedly presages.

Mr. Fessenden dismisses these very conclusive proofs that the stations are being worked commercially, by saying that most people are aware of the way in which Press telegrams are expanded. This general assertion is valueless when set against the definite statements of the *New York Times*, that "its wireless despatches from Europe come to it in excellent shape, comparing favourably with those by cable: and that the tests to which it had subjected the Marconi service proved conclusively that wireless telegraphy for long messages has passed the experimental stage, and is an established scientific and commercial fact."

The *New York Times* has no interest in the service other than to get cheap Press messages, and its statements from experience seem unanswerable. I may say, however, that in the despatches in question only the ordinary telegraph contractions are used, such as omission of prepositions and conjunctions where the context is clear without them.

Such contractions are used whether Press messages are sent by cable or by wireless, and Mr. Fessenden might as reasonably urge that the large number of Press messages transmitted by the cables afford no evidence of the cables being capable of commercial operation!

Mr. Fessenden, having failed to make good his statement on the main point at issue, endeavours to distract attention from this fact by making a number of assertions of an unimportant character, which are, however, themselves incorrect.

We can, of course, take no responsibility for statements attributed to us by interviews, and Mr. Fessenden's statements with regard to the action of the Anglo-American Telegraph Co. in connection with the Newfoundland experiments, and with regard to the President's message in January, 1903, rest solely upon his bare assertions and are disproved by the facts.

It is idle for Mr. Fessenden to say that everyone knows that the message from the President to King Edward was sent by cable when he is unable to substantiate it; when Mr. Marconi and his assistants, who were at the transmitting and receiving stations, say the message was transmitted and received by wireless; and when the trans-Atlantic wireless transmission of that date had been verified by the Italian Government.

It would occupy too much of your space to publish the correspondence between Mr. Marconi and the Anglo-American Telegraph Co. at the time of the Newfoundland experiments, and it has, I understand, already been made public. The facts are, however, that the Anglo-American Telegraph Co. asserted its commercial monopoly in Newfoundland in the most peremptory terms; it demanded that Mr. Marconi should desist at once from his experiments and remove his apparatus; and it threatened legal proceedings if its demands were not complied with.

While we did not admit the contentions of the cable company with regard to its rights in Newfoundland, it was hardly worth while to pursue experiments which themselves would probably result in litigation, and which would almost certainly involve it if they had any commercial outcome. As the experiments had a commercial object, and as that object could be attained on the mainland without the trouble of disputing the Anglo-American Telegraph Co.'s alleged rights, the experiments were continued in Canada.

The apprehensions of the Anglo-American Telegraph Co. manifested in the correspondence contrast somewhat strangely with the loud assertions of the cable companies,

when they had collected themselves after their first scare, that there was nothing to fear from wireless competition with the cables; but while the fears entertained by the Anglo-American Co. have no doubt been justified, possibly it may have had subsequent cause to regret the manner in which it manifested its apprehensions; and this may explain the suggestion which is now advanced, that it did not really mean to stop Mr. Marconi's work when its solicitors wrote, "Our clients cannot and will not permit you to proceed any further with the work you are now engaged in here . ."

Marconi's Wireless Telegraph Co., Ltd.,
H. Cuthbert Hall, *Managing Director.*

London, W.C., *January 21st*, 1908.

Electrical Cooking and Heating Appliances: Why they do not Sell.

Articles of a more or less technical nature dealing with the state of the electrical trade in many aspects have been common for some time in the Press.

The writers of such articles usually divide the trade up into several heads—the Manufacturer, the Contractor and the Central Station man, each of whom come in for a considerable amount of hostile criticism. There is, however, a fourth party, very insignificant in size but loud in noise—viz., the Theorist. Many solutions of the difficulties under which the electrical trade is supposed to languish are shown in some form by this gentleman on paper, but the practical man does not often rush into print, and he is not usually guided by the theorist's lessons.

One of your contemporaries has taken up the question of the sale of heating apparatus, asking why such goods do not sell, and the blame is divided between the manufacturer and the central station man. The manufacturer does wrong in attempting to deal with the public through the contractor. He should "short circuit" the contractor, ignoring the central station man, and appeal direct to the public. This is the remedy prescribed for the lack of sales. Like most heroic remedies, this has a smack of dash about it which appeals to the eye. Upon examination, however, its practicability is, to say the least of it, somewhat disputable.

Think of what it means. The manufacturer, in addition to designing and making his goods and putting them upon the market in a wholesale form, is to create a vast selling organisation, which, to be effectual, must cover the whole of the United Kingdom, and is to call into being a great army of retailers in his own employ who are to take on the business of educating the public in electrical matters and of getting business from them. A very slight consideration of this project reveals at once insuperable difficulties. The first is capital. The capital required for such an organisation would be little short of immense.

The next would be the commercial risk involved in the foundation of such businesses. Every owner of a business knows perfectly well that a remunerative connection is not called into being at the stroke of a pen, and it would probably be five or six years before such an organisation began to simmer down to a paying basis. To put it in another way, it would be many years before the promoter was able to separate the sheep from the goats among his newly-found staff and his newly-established branches. I venture to say that such a scheme is utterly impracticable considering the necessarily limited nature of the electrical market.

The alternative method of getting at the public direct, without the interposition of either the central station man or the contractor, is advertising. Advertising is put forward as the panacea for most commercial ills, and unlimited advertising has been recommended for the electrical trade for some time. It masquerades in many guises—"publicity" being its favourite mask. Whatever may be its merits for central station purposes, it is utterly useless to the manufacturer, unless he has at his command a retailing organisation, such as has been mentioned previously. The retailing organisation may be that of the contractors, the central stations, or the manufacturer's own depôts; but without one or the other, advertising to get at the general public is wasted money. It is simplicity itself to insert advertisements in the daily or weekly Press, which will arouse interest and produce inquiries in great quantities from the general public. Fully 50 per cent. of these inquiries will be found to be prompted by curiosity alone. A further large percentage must be wiped off for people who do not know the nature of the goods about which they are inquiring, and who could not use them if they had them. Of the remainder, whom we will suppose are potential users of the goods, it will be found that nearly all of them need a great deal of detailed information which can only be given on the spot, and also require work to be done in the nature of wiring, or adaptation of wiring, to render the appliances ready for any use whatever.

This brings the manufacturer again face to face with the absolute necessity for a local representative or agent, and in cases where it has been tried it usually falls back upon that much-abused man, the contractor. It is quite impossible for any manufacturer situated either in London, Birmingham or Manchester, to send down to the Isle of Wight or to Norfolk to install a 30s. electric kettle. Upon examination it is, therefore, apparent that it is absolutely impossible for the manufacturer to dispense with the contractor. The contractor is an essential part of the electrical industry, and it should be the manufacturer's aim to support him and assist him by all the means in his power. Those manufacturers who are endeavouring by their business policy to "short-circuit" the contractor, as your contemporary puts it, are doing their best to ruin the industry as a whole. It is often urged that the central station men should do the contractors' work, and the analogy of the gas companies and their methods is brought forward, but I contend that when our industry is in the same state as gas is at present, the majority of us had better seek another livelihood. The gas companies buy of the manufacturer at atrociously cut prices, and retail to the public at a very small percentage of profit, so that a state of things has arisen in which it seems impossible to make respectable profits out of gas appliances, in any shape or form.

The Welsbach Incandescent Gas Light Co. recognising this, are doing their best to discourage all dealings through the gas companies, and are endeavouring by all the means in their power to render it possible for the ironmonger to deal in their goods with advantage to himself. Let those who glibly appeal to the central station for their salvation take a lesson from this. The aim of the central station is to sell current, and if they take upon themselves the business of selling the articles which consume the current, it only forms a subsidiary part of their business, and they will sell only the cheapest possible goods at the lowest possible price.

This I contend is inconsistent with the ethics of ordinary profitable trading, and no industry can prosper in which such methods are employed. One of our most prominent manufacturers has been openly urging the "short-circuiting" of the contractor, instancing the Singer Manufacturing Co. as an example of a manufacturing firm, who conduct all the branches of the trade, from the factory to the consumers themselves. There is one essential difference between the two trades which makes any such analogy imperfect, and that is, that electrical apparatus requires installing and a great deal of explaining, whereas the sewing machine is dumped inside the house ready for use. Electrical appliances always require the presence of a more or less skilled man to install them. The average run of consumer has a wholesome dread of electricity and of shocks, and will not buy anything unless under skilled advice, or what he considers such.

I think I have said sufficient to demonstrate conclusively that the contractor in some shape or form, forms an integral and essential portion of the electrical trade edifice, and that the correct policy of the manufacturer is not to "short-circuit" him, but to conduct his business on such lines as to allow the contractor a chance of obtaining a respectable livelihood.

Agnostic.

Production of Energy from Peat.

Mr. Charles Erith apparently knows more of the objects and intentions of the promoters of the Dublin and Central Ireland Power Undertaking than they do themselves, and so

he tells us that "the present scheme is to generate electricity at the bog, and to transmit it 25 miles into Dublin."

It is nothing of the sort. It is to supply electricity throughout an area described in the Bill, of which area Dublin forms only a part.

What can Mr. Erith know of our plans and objects? Not having heard of the gentleman before, we have not taken him into our councils. And yet he is able to tell us what we are after, and that we are going in for a 25-mile transmission scheme for a 13 per cent. load factor! Mr. Erith's "thought reading" is, however, at fault in this instance. He knows nothing—*can* know nothing—of the new works now under consideration for establishment in the vicinity of the generating station, some of which would provide a 90 per cent. load factor. We know what we are about, and he does not. He, therefore, sets up imaginary data of his own invention, and founds arguments thereon.

He says that I have shown that "the gas produced by 1 lb. of 8,644 B.TH.U. *chemically* dry peat is only 5,825 B.TH.U." Here, again, I did nothing of the sort. He has put in the words "*chemically* dry" himself. The experiment I referred to was not Dr. Caro's, but one made several months previously (I have not the date by me here), with "*air-dried*" peat, that is, peat containing probably about 25 per cent. moisture.

But what is the use of following the arguments of a gentleman who seems to think that what *he* has failed to accomplish, nobody else can do? There have always been croakers whenever a new project is started, and always will be, and if we were to take any notice of them, nothing would ever be accomplished. When I first went to Niagara for the International Niagara Commissioners, there were plenty of that sort, who sneered at the idea of constructing a tunnel tail-race of capacity for 125,000 H.P. in such an out-of-the-way place, and prophesied that we would not find work enough for the first 5,000-KW. set. Nevertheless, the promoters persevered, and now the horse-power has increased to such an extent that the New York State and Canada are disputing over the water rights, lest one should get more than their fair share and leave the other short. When the first steamer was projected to cross the Atlantic, one of these geniuses proved by figures, something after Mr. Erith's style, that it was impossible to construct a vessel to contain sufficient coal to carry it across. Another proved that it was impossible to pull a train up a moderate incline on a smooth rail. Others showed that the steam turbine would be such a steam waster that it could never come into practical use. In short, the croakers, like the poor, are always with us. I don't know what useful part they fill in the economy of nature, but it is one of those things that the doers have to put up with, and it is best to go on, and not waste time arguing with them.

John Sturgeon.

Dublin, *January 13th*, 1908.

It is rather unusual for an engineer who submits for discussion and publication the details of a scheme, to admit that he dislikes intensely the controversy resulting. It is also unusual to insinuate "ignorance and incapacity" instead of demonstrating any error in the evidence published against the scheme.

I willingly accept Mr. Tomlinson's correction that his proposed gas engine efficiency was to be 30 per cent. of the heat in the gas, which, with 25 per cent. producer loss, would be 22½ per cent. and not 30 per cent. of the total heat in the fuel. But I doubt if any gas engine maker would guarantee the lower figure.

Mr. Tomlinson complains that I altered Mr. Sturgeon's figure of 5,825 B.TH.U. of gas per lb. of air-dried peat, to 5,825 B.TH.U. of gas per lb. of chemically dry peat; but my letter expressly pointed out that Dr. Caro's figures were my authority for this correction.

Mr. Tomlinson's own figures are 8,644 B.TH.U. per lb. of chemically dry peat = 6,483 B.TH.U. gas, if producer loss is only 25 per cent.; but this shows that only 3,566 B.TH.U. gas can be produced from 1 lb. of air-dried peat.

Mr. Sturgeon's 5,825 B.TH.U. in gas of air-dried peat would involve 10,591 B.TH.U. in gas per lb. of chemically dry peat; and with 25 per cent. producer loss, this would involve the absurdity of 14,121 B.TH.U. per lb. of chemically dry peat.

Mr. Tomlinson, writing 10 days after the publication of my letter, ignores all my evidence showing the impracticability of his scheme, my points being:—

1. The 100 tons wet peat dredged, dried and delivered to producer at £5 19s. 2d., works out 18 tons at 6s. 7d. per ton.

2. Three tons of such peat at 6s. 7d. = 19s. 9d., are inferior value in practice to 1 ton slack coal at 14s. per ton delivered.

3. The 36 per cent. dryer efficiency, proposed with the waste heat from gas engine, is totally impracticable.

4. Assuming air-dried peat delivered to the producer at 3s. (instead of actual 6s. 7d.) per ton, and assuming the by-products to realise 3s., thus getting "fuel for nothing," the capital charges on the peat-gas-electric scheme would outweigh the fuel cost of 0·55d. per KW. in the existing steam station of the Dublin electricity works.

The evidence for these statements was given in my letter published in ELECTRICAL REVIEW of January 10th. No one has so far produced any evidence to the contrary.

Charles Erith.

London, E.C., *January 25th*, 1908.

The City Lighting and Measurement of Illumination.

I was very glad to see in the "Correspondence" columns of your last issue Mr. Roger T. Smith's interesting letter under the above heading, more especially as it shows that directly the measurement of illumination is seriously taken in hand, the point which I dealt with in my paper on Street Lighting, in 1905, is forcibly brought to notice.

The fact that Mr. Smith was measuring a well-illuminated railway station made it possible for him to use a photometer of the Trotter type, having a horizontal screen. Moreover, he was measuring the illumination derived from lamps with a very similar spectrum to the standard lamp, and these lamps were installed at a sufficient height to prevent any appreciable errors due to the cosine law. On the other hand, if Mr. Smith had attempted to carry out the same measurements in, say, the street outside lighted with incandescent gas lamps, he would probably have agreed with me that a flicker photometer with a screen inclined nearer to the angle of incidence gave much more accurate results. The accurate measurements of illumination and candle-power which he would then have obtained could easily have been converted to horizontal illumination, as he points out in Diagram 1 in his letter. But I would mention here that he does not do me justice when he says that I should not have taken into consideration lamps 2 and 3, as when photometering with the object of giving the results in horizontal C.P.F., I invariably include the light from all sources by taking measurements of each.

Leaving out the importance of the greater accuracy resulting from the method I use and advocate, I would ask Mr. Smith whether horizontal illumination is the only thing to be aimed at, and therefore the only thing to be measured. For instance, in Paddington Station there are several useful notice boards on the platforms, and though the horizontal illumination at these points may be high, this gives no criterion as to whether it is possible to read these notices or not. Hence it is necessary to know something more than the minimum horizontal illumination, namely, the minimum direct illumination, other than the horizontal illumination derived from the lamp vertically above you. This can be done if the measurements are made and the curves plotted in the same way as those in my article on the City lighting, which appeared in your issue of December 6th, 1907.

The only difference of any importance between the Trotter "Universal" photometer of to-day and the Trotter photometer of 1890 is that mentioned by Mr. Smith, namely, that the screen can be set to any angle. I have not found this such an advantage as one would imagine, as the time taken in setting it either to a correct horizontal or direct angle is more than is occupied in multiplying the readings by the cosine of the angle of incidence; more especially as, when using a screen at 45°, the correction necessary for the cosine over a very large range is so small as to be negligible.

Another reason for using a screen at an angle of 45° is

that it is convenient when using a flicker head, and I do not suppose there are any testing authorities who would use any other means for photometering lamps of different spectra in their own laboratories, so why should they do so elsewhere?

Therefore I cannot agree with Mr. Smith in hoping that all will adopt the principles laid down by Mr. Trotter, much though I appreciate the great value of the work done by him in this direction: and I was glad to note that at the Washington Convention the National Electric Light Association specified the "illumination perpendicular to the rays."

I quite agree with Mr. Smith that the height at which illumination measurements are made should be agreed upon, and have found in practice that a screen 4 ft. from the ground is a very convenient height.

I trust that Mr. Smith's excellent letter on this subject will induce other of your readers to give their views, and that in due course the matter will be dealt with by some properly authorised standards committee or similar body.

Haydn Harrison.

London, S.W., *January 21st*, 1908.

Heat-Dissipating Varnishes.

The article which appeared in your last issue gives the results of an experiment carried out by Mr. Warnes, from which he deduces that heat radiating enamels, or, as I prefer to call them, heat conducting enamels, as at present produced are of no value. This experiment may be easy for a careful engineer to carry out, but it would be very troublesome to obtain any great accuracy. It certainly reminds one of the old school experiments of fitting woollen and linen petticoats to copper vessels, and comparing results with polished and lamp-blacked vessels; which, although in that case very instructive, in the present case are almost useless.

Why not carry out a more simple experiment, and one which demonstrates clearly the practical use of heat-conducting enamels? Wind two similar coils with cotton-covered wires of the same size, &c., treating one with our "Varsulat" heat-conducting enamel and the other with black insulating varnish. Connect in series and send sufficient current through to raise the coils to red heat in, say, 30 minutes. It will be noticed that some time before the coil treated with heat-conducting enamel has reached redness the other is destroyed and will be conducting between the turns. After cooling it will be found that the coil treated with the heat-conducting enamel will still be quite useful and magnetic, and would, for example, continue to work an arc lamp for a long period, and, further, it would be little the worse for its overload if it were impregnated with an insulating varnish and put to work again. I have often carried out this and similar tests and know that others have done so too.

The article seeks to correct the manufacturers of these compositions, because they make them light in colour. Mr. Warnes' test did not prove his point, and he can rest assured that the makers are not all ignorant of the laws of heat radiation and conduction. What is the use of his curves without stating the thickness of covering? Was the air temperature the same at each test? Does the humidity of the air have any effect?

We have several reasons—all good ones—for leaving the preparation light. We could easily colour it, but long ago we found that white was as good as black for the purposes for which this material is used. Let one reason suffice, *i.e.*, that the use of one of the insulating varnishes is recommended in addition to the heat-conducting enamel, and let that be black as the black is better and cheaper. Even supposing that the experiment I have described did not show any marked advantage for the heat-conducting enamel, still it would pay any maker to use it. It is well known that cotton when heated to about 130° C. becomes brittle, and even if maintained at 50° C. for some time it loses its nature. This trouble is aggravated by the use of insulating varnish, but practically removed when heat-conducting enamel is used. This alone makes it more deserving of consideration than Mr. Warnes appears to think. Also he seems to desire a large insulation resistance between turns of wire on a coil. Few coils are in use with more than 100 volts between the turns, and cotton alone is a sufficient *insulator* for this. Mr. Warnes is much behind modern practice if he desires many megohms between turns, particularly in high-tension apparatus.

The use of such a semi-conductor is advantageous. When a material that is impervious and flexible and not affected by anything can be produced which is a bad conductor and a bad insulator, a great step forward can be made in electrical designs, and this want we, in common with other makers of heat-conducting enamels, are endeavouring to supply. No doubt we are a long way away from the ideal yet, but it is absurd to criticise on the evidence produced in the article under discussion.

There are several other points open to criticism, but this letter is already rather lengthy, and I fear to trespass further on your space.

Percy Good.

London, S.E., *January 21st*, 1908.

I must thank Mr. J. S. S. Cooper for his friendly criticism of my article on the above materials, in your issue of the 24th inst.

I take the word dissipating to mean, in the broad sense, both the conduction and radiation of heat—*i.e.*, the complete dispersal of heat. The claims for the varnishes which I mentioned in the article, as told to me, were that they would conduct the heat from the centre of the coil and radiate it away without the use of any black finishing coat. I am quite aware that the phenomena of conduction and radiation are distinct.

In my article, paragraph 2, lines 5 and 13, the word "radiators" is used when, perhaps, it would have been better to have employed the word "conductors" or "absorbers." On referring to my original manuscript I find the word conductors was used, and I can only put down the appearance of the word radiators to carelessness on the part of the clerk who transcribed the original manuscript.

As regards the test, the idea was to devise something quite simple which could be carried out by any electrical engineer, and which would give him at least some idea of the conducting and radiating properties of the varnishes under discussion. It would be absurd to expect the ordinary engineer to manipulate the complicated apparatus necessary to make very accurate tests. In the test given the coat of varnish has to conduct the heat before it can radiate it.

Now, it is a recognised fact that good heat-conducting materials are good conductors of electricity, therefore all we can do is to obtain a material which possesses the very highest insulating properties, and as far as is possible with this value, the highest heat-conducting property. In other words, we must be content to sacrifice heat-conducting property in favour of insulation.

Arthur R. Warnes.

Hornsea, *January 25th*, 1908.

Gas v. Electricity.

Your correspondent "Unconvinced," is mistaken in saying that I write as a gas man. I write as a judge. If he saw the gas journals, he would know that quite recently I fought a somewhat severe battle against an eminent gas engineer, in the columns of the leading gas journal, on behalf of electricity. He is wrong also, to my mind, in saying that a comparison should be made between the old fish-tail burner and the 16-c.p. incandescent electric lamp. It would be as reasonable to say that comparison should be made with the candles that most of us remember, and which were so largely used in our young days. The standard in these cases is the amount of light that is required by the average man, and that has considerably increased in the last 20 years. Electricity, I think, has been largely responsible for this, because the idea ruled, in the early days of the electric light at any rate, that more light was obtained by electricity, because it was a bright light. Users of gas in those days were quite satisfied with very poor light indeed, as long as they used gas, but immediately they adopted electricity they required a very much more

brilliant light. The advent of the Welsbach mantle has done a good deal to carry on the education of the average man and woman, in the direction of requiring more light. Since more light could be obtained by the expenditure of less gas, by substituting a mantle for an ordinary burner, the average man naturally got in the way of using more light. Your correspondent's contention, that the Welsbach mantle should be compared to the arc lamp, is also unwarranted. A group of mantles, burning with high-pressure gas, does give, for practical purposes, as much light as an arc lamp, but it is not pretended that a single mantle, burning under ordinary pressures, gives anywhere near the light of the arc, and it would be absurd to compare them. Your correspondent is also surely a little behind the times in referring to gas as unhealthy. Has he not read the recent report of Prof. Vivian Lewes, in which the Professor claims that gas is more healthy, inasmuch as the dread of carbonic acid is more or less unwarranted, and that the really unhealthy effects of crowded rooms are due to the micro-organisms given off from the lungs, the skin, &c., and that gas burns up and carries these off, through the ceilings and the walls, &c., leaving only the familiar black mass of carbon behind? The contention of Prof. Vivian Lewes has been accepted by the medical profession, and I can confirm him to a large extent. The room in which my secretary and I work for several hours a day for a large portion of the year, is warmed during winter by a flueless gas radiator, standing in the middle of the room. We not only have felt no ill effects, but we have been able to work in comfort, whereas no amount of fuel in the old-fashioned grate with which the room is fitted would give any appreciable warmth in even comparatively mild weather.

Sydney F. Walker.

Bath, *January 27th*, 1908.

Limits of Municipal Engineers' Authority.

In the Board of Trade Regulations for securing the safety of the public (No. 29), we read :—"The undertakers shall not connect a consumer's wires with their mains unless they are reasonably satisfied that the connection would not cause a leakage from those wires or fittings exceeding one ten-thousandth part of the maximum supply current to the premises."

Regulation 31 provides that :—"If any consumer is dissatisfied with the action of the undertakers in refusing to give . . . supply of energy to his premises, the wires and fittings shall . . . be tested for the existence of leakage by an electric inspector." And I imagine the dissatisfied consumer could act through his contractor.

Provisional Orders provide that undertakers may discontinue the supply to consumers who so deal with the energy supplied as to interfere with the efficient supply of energy to any other consumer.

Unless a corporation works under a special Act, a municipal engineer's authority is restricted within these limits.

It will be admitted that it would be unsatisfactory if central station engineers did not take any further test than that necessary to satisfy themselves that Regulation 29 was complied with. In the interests of the undertaking, of the consumer, and, indeed, of the contractor, it is better that the engineer should examine the installation more carefully than that.

It is exceedingly gratifying to an engineer when he meets an able contractor, such as your correspondent, who understands his work and does it thoroughly, for the engineer knows that good contractors are of great assistance to his undertaking. The contractor cannot fail to recognise that an engineer must, in the interests of his undertaking, be strict, in order to weed out those individuals—of whom there are a considerable number—whose work, if not carefully supervised, tends to bring electricity into disrepute.

It has frequently come to my knowledge that so-called electrical contractors when starting in this business are absolutely without experience and totally unfit to undertake such work, and they are only educated up to proper methods of carrying out electrical installation work by constantly coming in contact with the inspector who examines and tests the installations on behalf of the undertakers.

To a large extent, the contractor is dependent on the supply undertaking for his existence. I have found *bona fide* contractors that realise this, and have tried to comply with the engineer's requirements. These are framed in accordance with the character of the supply, from the engineer's experience of what is desirable and what is not. It quite often occurs that an engineer is not a vexatious, capricious fool, who endeavours to put unreasonable obstacles in the way of the progress of his own undertaking.

I have long ago arrived at the conclusion that it is absolutely necessary for a central station engineer to examine most carefully all work intended for connection to the supply.

S. E. Fedden.

Electric Supply Department, Sheffield,
January 21st, 1908.

"Contractor's" complaint, under the above heading, in your issue of the 17th inst., is one I consider of no more than ordinary experience, the only difference in the case put forward by him being simply that courtesy should have been shown by the supply authority in notifying the contractor of the intended inspection. No one can reasonably blame a municipal engineer for exercising what is acknowledged to be his legitimate privilege, to inspect the qualities of any installation about to be connected to his mains, and I am myself convinced that the general quality and character of the installation is of infinitely greater moment than the mere insulation test on its completion, and "Contractor" is quite wrong in believing that the latter, when up to the standard, is all that is required to ensure its being accepted by the supply company. One regrettable feature noticeable where competition between two or more supply companies exists in a particular district, is the absence of sufficient vigilance to ensure that only reliable work shall be connected to their mains. The natural result is obviously not one to raise the standard of the electrical contractor. In this particular instance mentioned by "Contractor," unless there is diversity of construction to be put upon the Institution rules, he had nothing to fear by following their regulations, and would in consequence be immune from damaging criticism. Without wishing, however, to appear unkind, it would be interesting to hear the other side.

Duncan Watson.

London, W.C., *January 21st*, 1908.

Electricity in Bulk.

We note in your Editorial "Electric Bulk Supply," of January 17th, 1908, you say that the Yorkshire Electric Power Co., Ltd., had taken over a lease of the electric lighting powers originally obtained by the town of Calverley. This is, however, not quite correct. Electrical Distribution of Yorkshire, Ltd., have taken over the orders of the Urban District Councils of Horsforth, Calverley and Farsley, and have made provisional agreements to transfer with the Corporation of Ossett and Urban District Council of Hipperholme. The Yorkshire Electric Power Co. are now giving a bulk supply to the Corporation of Pudsey and the Urban District Councils of Mirfield and Ravensthorpe, and have made an agreement with the Corporation of Brighouse, by which they will close down their station and take a bulk supply from the company for tramways, lighting and general use.

The experience generally of this company fully bears out your conclusion that the attitude of municipal antagonism towards the large power companies is ebbing.

Jos. J. H. Stansfield,
Secretary, Yorkshire Electric Power Co.

Thornhill, *January 21st*, 1908.

The Use of Ball Bearings on Electric Motors.

We have read with much interest the article in your number of January 10th in reference to the use of ball bearings on electric motors. There are, however, one or two points which we should like to draw your attention to, more

especially as our name is mentioned in the article, and it might appear as though the designs were ours.

In referring to fig. 5, you say that one of the larger or outer races of the bearing is fixed in between two end plates of the housing. This is not shown in the figure. It is, of course, as you very properly state, necessary to do this in small motors, where the side thrust is not sufficient to damage the bearings.

In fig. 9 the double thrust bearing is not shown correctly mounted in relation to the journal bearing. The two races of one journal bearing should only be fixed where the end thrust is only slight, and never where a thrust washer is employed. The correct way to do this is shown in fig. 12, where the outer race of the journal bearing is a sliding fit in its housing, and the centre race of the double thrust washer is clamped between the end cap and a flange in the housing.

We notice in a letter from one of your correspondents, in your issue dated the 17th, a statement that when the cages of these bearings are made in two halves, and held together by rivets, there is a constant tendency to force the halves of the cage apart. This has not been our experience at all. The effect of the balls upon the cage, of course, entirely depends upon the design of the cage, and we have seen a number of bearings both with built-up and solid cages so designed that the balls must not only tend to burst the cage apart, but the friction must also be very considerable.

The Hoffmann Manufacturing Co., Ltd.
G. F. Barrett, *Director.*

Detrimental Circulars.

With reference to Mr. Abraham's remarks under this heading, we wish to point out that the circulars mentioned were issued exclusively for the information of generating station engineers, and they refer to street lighting, not to private lighting. The price of current at 1½d. per unit is generally adopted by experts when comparing costs of outlay and maintenance of electric arc lamps with gas. Mr. Abraham will find ample proof of this on page 361 in last August's issue of the *Journal* of the Institution of Electrical Engineers.

Mr. Abraham should be aware of this, as also that our figures in this respect are quite correct.

British Arc Lamps, Ltd.
F. W. E. Schuer, *Manager.*

London, E.C., *January 22nd*, 1908.

Review of a Review.

As your reviewer has asked for a specific reference, may I suggest that he should look up Prof. J. J. Thomson's "Recent Researches in Electricity and Magnetism," (1893), p. 96 *et seq.*, sections 77-88, where he will find a very definite statement of experimental results on the electrodeless discharge, proving (1) the existence of a critical *gaseous* pressure; (2) the extremely high conductivity of rarefied gases for this type of discharge—equal to that of a 25 per cent. solution of sulphuric acid; (3) the ease with which an electrodeless discharge passes through a very long gaseous circuit, *i.e.*, the smallness of the potential gradient required.

As regards damping, I may point out that I mentioned the Marconi "plain aerial" and no other system. The measurement was necessarily made at the "Haven," Poole, which was one of the only pair of wireless stations in existence at that date.

I am interested to hear that some conduction systems in existence before 1899, when I first heard of the Armstrong-Orling experiments, were operated with a greater ratio of range to base line than 7,000/450 (or 15/1), which I instanced as a modern result. I have not seen a record of them, and the best results of Preece and Gavey give a ratio differing very little from 1/1. By the way, I see that the figures I gave last week apply to later work by the author of the paper to which I referred (L. Maiche) than was described in the reference; they were taken from Ruhmer's "Drahtlose Telephonie," of which an English edition will appear next month.

Finally, may I suggest that your reviewer should bear in mind that my book was written about a year and a half ago, and published ten months ago, and that in wireless, as in other things, "much water has flowed under the bridges since then"?

J. Erskine Murray.

London, W.C.,
January 22nd, 1908.

Thermal Storage.

I see in your leaderette of the 24th inst., when discussing the inquiry into the Greenwich boiler explosion, you say "you cannot understand why the unstayed drum was insured by the insurance company. It is certain that boiler experts generally would object to such an omission."

As a matter of fact, the designs of most of our thermal storage vessels are approved by the boiler insurance companies who advise our customers, and they generally inspect the work in detail while it is being manufactured, the only exceptions being those firms who decline to have anything to do with the boiler insurance companies. You also state that the ends are exposed to very considerable concertina action with every variation in pressure, and ultimate failure must inevitably occur. I have lately had the opportunity of carefully examining the inside of a thermal storage vessel which has been at work for ten years, and the ends did not show the remotest sign of the existence of any such action as you say takes place. I have also examined the insides of the ends of several other thermal storage vessels which have been at work for shorter periods, with similar results.

When referring further to the matter on page 146, you say thermal storage vessels have added a fresh danger to boiler houses; for should they become completely full of water they may be exposed to considerable shock or over-pressure from the action of the pumps, and, as a matter of precaution, it would be desirable that one safety valve of a thermal storage vessel should be of the spring-loaded variety in order to avoid the undesirable inertia of weights.

The above statements can, of course, only have been made owing to ignorance of the design of the thermal storage vessels made by my company, as, from their construction, it is physically impossible to produce any over pressure on them by means of the feed pumps, and in order to prevent any inconvenience that may arise owing to carelessness through the pumps being kept at work after the proper upper water level has been reached, we fit whistles with floats.

Up to the present, for very obvious reasons, we have never had occasion to fit thermal storage vessels with safety valves.

Halpin's Patent Thermal Storage, Ltd.
H. C. Davis, *Secretary.*

London, S.W.,
January 28th, 1908.

[Surely our correspondent is not prepared to maintain that an unstayed plate, such as the one in question, which supports a working pressure of some 200 tons, is not subject to the "breathing" action to which we have drawn attention? Such action undoubtedly must occur; and the inevitable result of its constant repetition, for a sufficient number of cycles, is to produce grooving along the line of maximum effect. As for the desirability of staying these large and almost flat surfaces, we are by no means alone in our opinion, and we believe that many thermal storage drums are already provided with stays, as not *all* boiler insurance companies are willing to dispense with them.

On looking into the matter referred to in the third paragraph, we agree that Mr. Halpin's arrangement appears to preclude the possibility suggested in our note; we hold, however, that safety valves should be fitted on every vessel containing high-pressure steam.—Eds. E.R.]

BUSINESS NOTES.

Electrolytic Copper in Russia.—An impetus to the production of copper was imparted in 1906, and the total quantity smelted amounted to 636,100 poods, as compared with 570,500 poods in the preceding year. The imports were 803,230 poods, and 1,139,000 poods in the two years respectively. The output in 1906 was the highest on record, but this was eclipsed in 1907, as 652,939 poods were produced in the first nine months, and the total for the year is estimated at 930,000 poods. A scheme is now being promoted for the formation of a syndicate to regulate the outturn and selling prices. As far as electrolytic copper is concerned, it is reported that a group of copper producers have constituted a company under the title of "Electrolyse," for the establishment of electrolytic copper works. At present the consumption of electrolytic copper ranges from 400,000 to 500,000 poods per annum, whereas the manufacture of this quality is exceedingly limited. The new company proposes, first of all, to erect a central works, probably at Moscow, and it is intended to apply for a reduction in the railway rates for the transport of ore from the Ural, the Caucasus, and Siberia, to the works, and thence to the places of consumption. In the meantime, the owners of the Demidoff Copper Works, in the Ural, have asked for permission to export a portion of their production of ordinary copper for the purpose of electrolytic refining, with the privilege of reimporting it free of duty, which now amounts to five roubles per pood. Another company has been formed under the title of the Mièd, for the direct export of copper and the construction and operation of works for the production of electrolytic copper. Among the founders are M. Zeidler, formerly manager of the Kertch Works, and MM. Figner, Starinkeyitch and von Kruze.

Book Notices.—*Who's Who 1908* (with which is incorporated "Men and Women of the Time"). London: A. & C. Black. 10s. net.—This most useful annual hardly requires any recommendation. It is a work which every man who desires his library to be complete must have upon his shelves for reference, and many professional and business men find it an interesting and useful book to have in their offices. This year's issue contains some 22,000 biographies, and as each of these has been submitted to the subject for personal revision, the details may generally be regarded as accurate. Two one-shilling companion books to this volume, are (1) "Who's Who Year-book"—consisting of the table matter which was formerly a feature of "Who's Who" itself; it is practically a directory to members of Parliament, King's counsel, University professors, the Press, hospital and all leading bodies, clubs, and associations religious, political and social, railways, &c.; (2) "The Writers' and Artists' Year-Book," which is a list of publications of interest to those engaged in the literary and art professions with notes of their addresses, kind of articles, &c., published, class of illustrations, and so forth.

"L'Année Electrique, Electrothérapique, et Radiographique." By Dr. F. de Courmelles. Eighth year. Paris: Ch. Béranger. 1908. Price 3.50 fr.

"Cours d'Electricité." By H. Pellat. Vol. 3. Paris: Gauthier-Villars. 1908. Price 10 fr.

"Les Decouvertes Modernes en Physique." By O. Manville. Paris: A. Hermann. 1908. Price 5 fr.

"Arithmetic of Electrical Engineering." London: Whittaker and Co. 1908. Price 1s. net.

"Fortschritte der Elektrotechnik." 1907. Part I. Berlin: Julius Springer. Price M. 8.

"Wireless Telephony." By E. Ruhmer. Translated by J. Erskine-Murray. London: Crosby Lockwood & Son. 1908. Price 10s. 6d. net.

"Mesures Electriques." By E. Gerard. Paris: Gauthier-Villars. 1908. Price 12 fr.

Messrs. Harper & Brothers announce the following for immediate publication:—"Steam Boilers, Engines and Turbines." By Sydney F. Walker.

Catalogues and Lists.—THE PULSOMETER ENGINEERING CO., LTD., 61 and 63, Queen Victoria Street, E.C.—44-page pamphlet, entitled "Pulsometer Manufactures." Their well-known pumping machinery specialities are illustrated and some details are given in tabular form, showing sizes, prices and code words of their steam pumps, belt and electrically driven centrifugal pumps, turbine pumps, feed pumping engines, the "Reading" sinker, torrent type filter, and the Pulsometer water-tube boiler.

MESSRS. MAPLES, LEACH & CO. advise us that, for the fourth time, their stock of the little 6-in. slide-rule memento has been exhausted. They will be willing to forward further rules to any reader sending 9d. in stamps.

MESSRS. BOULTON & PAUL, LTD., Norwich.—Four-page publication, giving prices and particulars of their petrol and paraffin engines for direct coupling to dynamos and pumps.

ENDOLITHIC MANUFACTURING CO., LTD., 61½, Fore Street, London, E.C.—New circulars relating to their name-plates in ivory, bone and metal, also specimens of same.

THE JONES-WESTWOOD ELECTRICAL MANUFACTURING CO., Elland Road, Leeds.—Hanging card, upon which is printed an abbreviated price list of motors of the open protected type, from 1 to 100 B.H.P.

From MR. J. OWDEN O'BRIEN, of 6, Bank Street, Manchester, we have received a small Inventors' Pocket-Book. Some 16 pages of matter relating to the new Patents Act and Trade Marks are separated by 16 pages of squared paper for notes.

THE PHŒNIX ELECTRIC HEATING CO., LTD., 17, Morwell Street, Tottenham Court Road, London, W.C.—In this 144 pp. catalogue a large variety of electric heating apparatus and utensils is set out, altered prices being indicated in a number of cases. The lines illustrated include their electric ovens and cupboards, carving table and hot closet, grillers, hot plates, flat irons, muffle, tube and other furnaces, drying ovens, ordinary cooking utensils, radiators and other heaters, electric baths, vulcanisers, electric log and coal fire radiators, electric geysers and many other things.

THE CONSOLIDATED ACCESSORIES CO., 27, Clement's Lane, London, E.C.—This company having been appointed agents for Messrs. Geo. W. Green & Co., of Lambeth, for the sale of their traction specialities within the United Kingdom, have in circulation illustrated leaflets describing both the Pringle patent trolley standard earthing device and the trolley tension indicator, also their two-bladed rail cleaners.

THE ELECTRIC AND ORDNANCE ACCESSORIES, CO., LTD., Aston, Birmingham.—A number of leaflets showing by illustrations, describing, and giving prices of, "Eclipse" electric heaters, "Stellite" dynamos and C.C. motors, "Victor" miniature arc and flame lamps.

THE STERLING TELEPHONE AND ELECTRIC CO., 200, Upper Thames Street, E.C.—Pamphlet No. 132, describing, with illustrations, a number of the company's specialities; these include "Parlyphones," wall and table sets of many different designs, waterproof mining and ship telephones and bells, magnetos, automatic intercommunication sets, central battery telephones and switchboards, of many patterns.

From ELECTRICAL INSTALLATIONS, LTD., of 70A, Basinghall Street, E.C., we have received a convenient letter-opener.

MESSRS. ATTWATER & SONS, Hopwood Street Mill, Preston.—Small pamphlet giving brief information concerning their Peerless Leatheroid insulation.

THE MORK PATENT PULLEY BLOCK CO., 42/44, Moor Lane, London, E.C.—New lifting tackle and crane catalogue (E. 1908) just issued. In some 40 odd pages (glazed paper) there are given illustrated descriptions of their "Mork" and "Original" pulley blocks, electric travelling pulley blocks, crabs and cranes, wall cranes, portable hand cranes, &c. The "Nonfrict" system of overhead runways, and the "Mork" scaffold chains, are also fully described and illustrated.

THE ELECTRICAL CO., LTD., 121-125, Charing Cross Road, W.C.—Pamphlet No. 257 (12 pages) containing general descriptive matter illustrated by some good half-tone views, relating to the individual drive of ring spinning machines.

THE GENERAL ELECTRIC CO., LTD., 71, Queen Victoria Street, E.C.—Illustrated catalogue (tenth edition) of telephones, switchboards, fire alarms, electric clocks, &c., ranging from small domestic sets to common-battery exchanges. Amongst other items are an improved form of "hygienic" telephone, inter-communication sets of a variety of types, including common-battery sets, watertight telephones and bells, telephones specially constructed for the tropics, sets without exposed terminals, a new parallel-motion device for table sets ("Phon-Eze"), navy telephones, private branch exchange switchboards, and accessories of all kinds.

Trade Competitors as Vice-Consuls.—According to the *Pall Mall Gazette* there is growing dissatisfaction in the Midlands at the practice of appointing traders, or directors of trading firms, as Vice-Consuls to foreign countries. "This is said to be particularly hard so far as the steel trade is concerned. One leading manufacturer has just received, in open competition, the order for a special line of a particular quality of steel, from a Continental firm, and it will be necessary for him to swear his invoice and disclose the price to his chief competitor for the business, who happens to hold the position of Vice-Consul for the country to which the material is to be consigned. The injustice of this is greater in the case of ordinary business, for the name of the customer is disclosed as well, and the Vice-Consul, having then the material, price, and customer before him, is placed in a position of undue advantage with regard to future trade. The subject is certainly one which needs ventilation."

Electric Lifts.—The KEIGHLEY ELECTRICAL ENGINEERING CO., LTD., has received orders for one electric passenger lift and two electric goods lifts for Messrs. Pugh, Davies & Co., of Dale Street, Manchester, and for one electric passenger lift for the Grand Hotel, Scarborough.

Installation Contracts.—We understand that ELECTRICAL INSTALLATIONS, LTD., Bassishaw House, Basinghall Street, E.C., have some important contracts on hand, including a complete power, light and telephone equipment for the Marmite Food Extract Co., Ltd., at their new factory, Camberwell. Installations are also being provided for, among others, The London and Paris Exchange, Parr's Bank, Ltd., Slater's, Ltd., Oxford Street, &c. An elaborate system of secret service telephones and bells have just been installed for Messrs. S. Pearson & Sons, Ltd., contractors, at their new offices, the Old Whitehall Club, Parliament Street, S.W.

Dissolutions and Liquidations.—HARRY W. COX, LTD.—Creditors are to send particulars of debts, &c., to Mr. A. R. King Farlow, 4, King Street, E.C., the liquidator, by February 10th.

MUTUAL TELEPHONE CO., LTD.—This company is winding up voluntarily, with Messrs. W. Thomson & F. Scott as liquidator.

D. SANTONI & CO. (1906), LTD.—At a meeting held on January 14th it was resolved to wind up voluntarily, with Mr. J. H. Duncan, 39, Coleman Street, E.C., as liquidator.

LIONEL ROBINSON & CO., LTD.—A meeting of members is to be held on February 25th at 21, Ironmonger Lane, E.C., to hear an account of the winding up from the liquidator (Mr. H. J. Page).

Tantalum Lamps.—MESSRS. SIEMENS BROTHERS DYNAMO WORKS, LTD., are introducing a new type of tantalum lamp—namely, 16 C.P. for 100 to 120-volt circuits. We are informed that this lamp is not more fragile than the other types of tantalum lamps and will burn in any position. Messrs. Siemens at present carry a small stock in London, which they are rapidly increasing to meet the large number of inquiries they have received for lamps of this type. They have also issued an opal tablet advertising tantalum lamps, copies of which can be obtained by sending trade card.

Bankruptcy Proceedings.—WILLIAM MARSHALL, electric cable jointer, 49, Paget Road, Plumstead, Kent.—In this case the Receiving Order was made on January 9th on the debtor's own petition, and the statement of affairs shows liabilities amounting to £218, to meet which there are assets consisting of cash deposited with the solicitor for costs of petition £15, and furniture £3, making total assets £18, from which has to be deducted preference claims in respect of rent, rates, &c., amounting to £7 13s., leaving net assets £10 6s., and disclosing a deficiency of £207 6s. The debtor's wife claims a freehold house at Plumstead, and certain furniture, as her own property. The debtor ascribes his failure entirely to liabilities contracted by his wife without his knowledge, and to heavy expenses of illness of his wife and child. The first meeting of creditors was held last Monday at the office of the Official Receiver, 132, York Road, Westminster, S.E., Mr. J. B. Knight, assistant Official Receiver, presiding. No resolutions were passed, and the estate was left with the Official Receiver.

Electrical and Trades Exhibition.—The somewhat stereotyped form of the usual electrical and trades exhibition was varied in the case of the one held this week at Richmond by the exceptional prominence of the electrical section. The Richmond (Surrey) Electric Supply and Power Co., Ltd., interested themselves in the matter, and made special provision for supply, &c., with the result that the electrical interest certainly dominated. The special feature of the exhibition was the cooking and heating section—a branch of the industry which the Richmond Power Co. have set themselves to specially cater for. The social status of Richmond as a town makes it a very promising area for extension of supply for this purpose, and the electrical exhibit was specially organised to assist in this direction.

Annual Dinners.—The annual dinner of the employés of Laurence, Scott & Co., Ltd., Norwich, was held at the works on Friday. Mr. R. Laurence presided over a party of nearly 200. Mr. W. Alcraft, who discharged the duties of vice-chairman, proposed the toast of the evening, "Success to Laurence, Scott & Co., Ltd.," and took the opportunity of thanking the firm for its kindness in erecting such a fine dining-room. He observed that the fact that the old dining-room, which was opened nine years ago, was required for other purposes in consequence of an expanding business, was an additional cause for congratulation. The chairman, in responding to the toast, said the quality of the work of the employés of the firm had enabled the company to secure the position to which it had attained, and the high standard of the past must be maintained in order to secure a continuance of business. The company was doing a large and increasing amount of Admiralty work, and orders were in hand for three new vessels of the important *Dreadnought* class, while 73 of the company's machines had been put into the battleship *Lord Nelson*. The company was also well represented in the commercial world, and the Cunard steamers *Lusitania*, *Mauretania*, and *Asturias*, had many of its machines on board. Other toasts followed.

The members of the staff of the ELECTRIC CONSTRUCTION CO., LTD., dined together at the Star and Garter Hotel on Saturday evening, 25th inst. The chair was taken by Mr. William Bulloch (manager of the E.C.C. and president of the Wolverhampton Chamber of Commerce), supported by Mr. William Buchanan (chief engineer) and the departmental heads. The dinner was followed by a smoking concert, in which the staff proved that it is no less highly endowed with musical than with engineering talent. The toast list was limited to one item—"The King"—proposed by Mr. Bulloch.

Trade Announcements.—MR. W. GRIFFITHS, 25, Botanic Avenue, Belfast, has been appointed representative for Ireland by Messrs. Edward Bennis and Co., Ltd., Little Hulton, Bolton. MR. E. HARRIS, the firm's agent for East Yorkshire, has changed his address to "Hill Crest," Horsforth, Leeds. MR. F. K. WOODROFFE, their agent for Liverpool, North Wales, North Stafford and part of Chester, has removed to "Melville," Hoole Road, Chester.

LIGHTING and POWER NOTES.

Ashton.—The B. of T. has decided to dispense with gas and to light the new workhouse, hospitals, and nurses' homes with electricity at a cost of £6,000.

Baildon.—An E.L. scheme is to be submitted to the U.D.C. by a Bradford company.

Bexley.—The U.D.C. has passed a resolution in favour of a scheme of wiring premises for the electric light on a rental basis at 8d. per point per quarter. A loan is to be applied for to carry out the scheme.

Clackmannan.—There is a proposal to introduce electric light at the County Hospital, at a cost of £250.

Continental Notes.—FRANCE.—A central station is to be established to provide the necessary energy for electric lighting and power purposes in connection with the canal between Caen and the sea.

A fire occurred on January 23rd in the electric light station at the Central Markets, Paris, and many of the cables were destroyed. The markets were practically undamaged, but the entire district is without light.

SWEDEN.—A proposal is before the Government for the purchase of two paper mills and their water rights, which would enable the State, by regulating the falls of the Goetaelr River, to dispose of 200,000 E.H.P., which are estimated at a capital value of 15½ million kroner.

Dorchester.—The B. of T. has revoked the E.L. Order for 1901 as to the whole area of supply.

Dunfermline.—Sir A. B. W. Kennedy has advised the T.C. to transfer its E.L. Order to the Fife Electric Power Co., in preference to providing its own plant or taking a bulk supply.

Heanor.—The local Tradesmen's Association has appointed a deputation to wait upon the U.D.C. with a request that the Council shall take up the E.L. question, and install an undertaking in the town.

Heath Town.—The U.D.C. is considering terms for public lighting submitted by the Midland Electric Corporation for Power Distribution, Ltd.

Hendon.—The U.D.C. has decided not to offer any objection to the transfer of the Electric Lighting Prov. Orders from Messrs. Crompton & Co., to the Hendon Electric Supply Co., Ltd. It has been agreed to petition against the London and District, and the London Electric Supply Bills.

Kingston-on-Thames.—The T.C. has decided to apply to the L.G.B. for a loan of £12,600 for electricity purposes, the principal items being £3,210 for mains; £2,230 for sub-stations, transformers, &c.; £2,850 for services; £600 for disconnecting section pillars; £300 for arc lighting; and £1,232 for incandescent electric lighting.

Littleborough.—The B. of T. has informed the U.D.C. that it has deferred, for a year, consideration of the revocation of the E.L. Order, 1900.

London.—MARYLEBONE.—Messrs. D. H. Evans & Co., of Oxford Street, are giving, for two weeks, a demonstration of electric cooking apparatus, and a request from the firm to be supplied with the necessary electricity free has been granted. Messrs. Evans have allowed the use of a stall on their premises for the purpose of exhibiting the Council's pamphlets, &c.

HAMMERSMITH.—The electrical engineer has prepared reports upon immediate extensions of plant, &c., and further developments rendered necessary to enable the Council to supply consumers over and above those already contracted for, without undue risk. It is suggested that the boiler plant be increased by placing two boilers in the No. 1 boiler house and equipping all five boilers with forced draught, at a cost of £4,400. Also that the main switchboard be enlarged and removed, £1,000 being provided for this year's work; that a sub-station be put up in the Hammersmith Road, cost, £283. Additional static transformers, mains extensions, extension services, &c., also figure, and the expenditure to March 31st, 1909, is estimated at £3,000. The Electricity Committee reported on Monday that it had approved the engineer's report, and the Finance Committee likewise reported having passed an estimate for the work suggested to the total of £12,190. The last-named Committee points out that, including the sum mentioned, the total projected capital expenditure on the electricity undertaking for the period ending March 31st, 1909, is £24,449 (£16,895 expenditure having been already authorised), made up as follows:—Generating station, £5,000; transforming gear, £2,253; sub-stations, £4,828; mains, £9,368; services £3,000. Application is to be made to the L.C.C. for a loan of £10,000 on account.

WESTMINSTER.—The Law and Parliamentary Committee has decided that in connection with the electricity Bills to come before Parliament, it considers that the Council's interests would be served by restricting the existing companies to their present functions and keeping intact the powers of purchase under the Electric Lighting Acts, whilst entrusting a separate undertaking with bulk and power supply. It has been decided to petition against all three Bills.

STOKE NEWINGTON.—At the last meeting of the B.C., deputations of ratepayers were received in opposition to the proposed scheme for the establishment of a generating station. It was reported by the joint committee of the Electric Lighting and Public Health Committees that the North Metropolitan Electric Power Supply Co. had agreed to a supplementary agreement setting out the charges in respect of the proposed extension which are to be charged against the general revenue and to be borne by the company. The joint committee recommended the agreement for sealing by the Council, which was carried. A debate extending over four hours ensued upon the motion for the adoption of the joint report of November 13th last, recommending the erection of a generating

station and the provision of plant at an estimated cost of £3,700 In the result the motion was carried by a majority of two.

WOOLWICH.—The B.C. has decided to petition against the London Electric Supply and London and District Electricity Supply Bills; but not the Westminster and Kensington Electric Supply Cos.' Bill, which, it is considered, does not interfere with local interests.

PADDINGTON.—The B.C. has decided that the above three Electricity Bills do not warrant the expenditure necessary to effectively oppose them, but it has been decided to draw the attention of the L.C.C. and the Borough Parliamentary Representatives to the Council's objection to proposals in the Bills for nullifying the Council's purchase clauses in its area.

Long Eaton.—The U.D.C. has decided to oppose the application of the Draycott Gas Co. for powers to supply electricity in the district, so far as the parish of Wilsthorpe is concerned.

Norwich.—The T.C. has decided to petition against the Great Eastern Railway (General Powers) Bill, which seeks power for the company to supply energy to its tenants and others.

Oldham.—A L.G.B. inquiry was held on January 22nd into the application of the T.C. for a loan of £1,500 for the provision of electric meters and indicators. There was no opposition.

Stourbridge.—The U.D.C. has settled the action taken against the Shropshire and Worcestershire Electric Power Co. with reference to the completion of the transfer of the E.L. order for which the company undertook to pay £500. Under the settlement the company will carry out the transfer of the order and pay the £500 and the costs.

Taunton.—A loan of £2,000 for three years' supply of meters and cables has been applied for by the T.C.

Trowbridge.—The B. of T. has informed the U.D.C. that it proposes revoking the E.L. order obtained by the Council in 1904, and subsequently transferred to the Weston Electric Distributing Corporation.

West Ham.—The engineer reports that £14,564 has been spent out of the loan for generating station extensions; balances to be paid on contracts bring this amount up to £17,905, or some £828 above the estimate. One of the engines has been sold to the Government of Uruguay, and a motor-generator installed on its site, and a second motor-generator will be installed if another engine is disposed of. Expenditure at Silvertown amounted to £22,706, as compared with £17,212 estimated for; on ordinary distribution £24,022 was spent, as against £23,300 estimated for; and sanction to a loan for the excess expenditure on these and other items (£7,045) is to be applied for. Application is also to be made for sanction to borrow £64,880 for further extensions to the generating and distributing plant, being the estimated requirements until March 31st, 1910.

TRAMWAY and RAILWAY NOTES.

Continental Notes.—GERMANY.—The scheme for the construction of a suspended electric railway in Berlin has made a slight step in advance by the recent completion of a short section for the express purpose of securing the approval of the local authorities. The latter desire to be convinced that the erection of such a line between the north and the south of the city would not be detrimental to the appearance of the streets and would not interfere with the ordinary vehicular traffic immediately below the underside of the passenger coaches in contemplation. Pending a decision of the municipal authorities on the subject, the question also concerns the Prussian Ministry of Public Works and Railways, whose consent is also needed to secure the execution of the scheme, and whose attitude towards the original suspended railway between Barmen and Elberfeld shows that full consideration is being given to the proposal as it affects the German capital. This assumption is drawn from the fact that the Ministry recently requested the Royal Railway Direction at Elberfeld to induce the managers of the Barmen-Elberfeld Railway to submit proofs that the suspended railway could accommodate longer trains on curves, at points or crossings and in turning round. The managers agreed to the suggestion, and the trials took place on January 18th, in the presence of representatives of the railway authorities and of other persons, the train being composed of six coaches. The first trial, which was at the ordinary working speed of 25 miles an hour, proceeded satisfactorily, especially on the curves and also at the end turning place of a radius of 9 metres, although the speed was of course reduced in the latter position. As a speed of 31 miles an hour is projected for Berlin, the train was then tested at 33½ miles per hour, and in this case also the running was quiet and more pleasant, it is said, than what one is accustomed to on the ordinary double-rail railways in Germany.

HOLLAND.—The Government proposes to construct electric tramways in the Limburg districts, both for goods and passenger traffic. Other lines projected are: Maesbricht to Vals (on the main road); Devente to Epe and Devente to Appeldoorn Voorst, Zutphen and Diepew; Amersfoort to Soost (C. W. J. Luten van Doelen Grothe, bourgmeister).

SPAIN.—The Seville Tramways Co. has applied for a concession for working an electric tramway in that town, and a period of one month from the date of publication is allowed for the presentation of further proposals on more favourable terms.—*Board of Trade Journal.*

Snr. D. Gumersindo de Cossa y de Rosa, Barcelona, has obtained the concession for the electric tramway to be constructed between Vallirana and Barcelona.

RUSSIA.—The Moscow municipality is to issue a loan of 18,700,000 roubles (£1,870,000) for the construction of the new tramways. It appears that sanction to the formation of a company to carry out the work is now being obtained.

Glasgow.—Colonel Yorke, of the B. of T., visited Glasgow on Tuesday, the 14th inst., and conducted an inquiry into the circumstances attending the tramway accident on January 3rd, when two persons were killed and many injured. Henry Jackson, "controller," stated that the mechanical portions of the cars were examined every third night. Car 986, which met with the accident, was examined on January 1st, and so far as the controller was concerned it was in perfect condition. There was no defect in the reversing handle. John Milligan, truckman, said he examined the mechanical fittings in connection with the trucks, hand and magnetic brakes of car 986 on January 3rd, and everything was in order. Walter Child, the conductor of the car, said that on the second journey at the top of the hill at the Soringburn terminus, the reversing handle could not be removed. Dolan, the driver, made no objection to proceeding, the reversing handle being left fixed on the rear controller. Witness described the collisions, and said he did not notice where the driver fell off. John Muirhead, motor inspector, described the circumstances under which he found car 986 at Springburn. He, Falconer, Mackenzie, Dolan and Child endeavoured to move the handle and bring it to a neutral position, but they were not successful. He knew he said that this trouble did not affect the operation of the power or the electric brake. Dolan had no hesitation in leaving, and witness had no hesitation in allowing him to go. Alexander Gerrard, who said he had charge of the car building and repair shops at Coplawhill, stated that he examined car 986 on January 9th. Witness found controller No. 1 (that was the undamaged one) with the reversing handle stuck in the forward position. That was owing to a pawl dropping, due to a pivot having become unscrewed. No. 2, the damaged one, had the main handle on full breaking point and the reversing spindle in the forward position minus lever's handle. The entire cabling of the car was in perfect order. Witness tested the electric brake with a new controller and found that the connections outside the controller and the brake shoes were in perfect order. He also drove the car from the other end, and found it in the same condition. The hand-brakes on both ends were also tested by him and found in good working order. After further evidence, the inquiry was adjourned. A report will follow in the usual course.

Haslingden.—The electric tramway departments of Haslingden and Accrington have arrived at an understanding for through booking arrangements.

Loch Lomond—Glasgow.—It is proposed to start work on the Dumbarton-Alexandria (Loch Lomond) and Dumbarton-Dalmuir sections of tramway next month. Messrs. J. G. White & Co. are the contractors for the scheme, which is in the hands of the Dumbarton Burgh and County Tramways Co., Ltd., and will absorb the Dumbarton tramways and utilise the generating station provided for the latter. The cost of the work is estimated at £144,000.

London.—L.C.C.—The Parliamentary Committee has recommended the L.C.C. to seal petitions for presentation, if necessary, against the Great Northern, Piccadilly and Brompton Railway Bill, and the Metropolitan District Railway Bill; the Highgate Hill Tramway, London and Windsor Motor Roads, Tramways and Tramroads, Metropolitan Electric, and West London, Barnes and Richmond Tramways Bills; and against the London and District Electricity Supply Bill, the London Electric Supply Bill, and the London (Westminster and Kensington) Electric Supply Companies' Bill.

PADDINGTON.—At Tuesday's meeting of the B.C. it was agreed to consent, for the purposes of the Standing Orders of Parliament, to the introduction, in the coming session, of the Metropolitan Electric Tramways Co.'s Bill seeking powers to extend its electric tramways from Lock Bridge (Harrow Road), by means of a double line of tramway along Harrow Road to a point near Edgware Road.

LEWISHAM.—A deputation of the B.C. has recently interviewed the L.C.C. Highways Committee with regard to the question of tramways at Forest Hill. The L.C.C. has powers to construct lines connecting Forest Hill, Lewisham and Dulwich, and the point in dispute appears to be the system on which the lines shall be constructed.

L. & N.W.R. Co.—This company has recently informed the Watford U.D.C. that the Euston-Watford electric railway scheme is being delayed owing to the unfavourable conditions attaching to the raising of the £2,336,412 required for the work. The scheme includes the building of an underground station at Euston at a cost of £202,000.

Richmond.—The promoters of the West London, Barnes and Richmond Tramways Bill state that they are prepared to forego the adoption of overhead construction in the Sheen, Richmond and Upper Richmond Roads, in deference to local sentiment.

Warrenpoint (Co. Down).—It is stated on good authority in Warrenpoint that a company is about to be formed to purchase the present tramway from Warrenpoint to Rostrevor, and to continue it as an electric railway to Newcastle, the favourite watering place and golfing resort on the east coast. The proposed extension would open up a new line of country *vid* Kilkeel and other seaside towns on the County Down coast.

West Ham.—Mr. H. E. Blain (tramway manager) has reported that the cost of constructing 20 top covers at the tramway depôt averages £67 per car, which compares with £97, the contract price paid to Milnes, Voss & Co. The committee has decided in favour of 20 additional cars being fitted with top covers at the depôt.

West Hartlepool.—The N.E. Railway Co. are about to erect an electrical sub-station in the town for the purpose of supplying their power and lighting requirements.

TELEGRAPH and TELEPHONE NOTES.

Dutch East Indies.—The telegraph system in 1905 comprised 14,147 km. of line and 19,179 of wire, the latter being composed of 13,858 of aerial wire, 5,221 of submarine and 99 km. of underground wire. In 1905 there were 586 offices, an increase of 11 over the previous year; 500 were owned by the Government, 56 by railways and 30 by private undertakings. Inland telegrams numbered 204,230, containing 6,818,671 words, while international telegrams totalled 149,051, and words 1,337,299. Besides these there were 56,366 telegrams containing 698,737 words in transit. The average number of words per telegram was 11·86 for the inland system, 8·31 for the international, 33·58 for inland official telegrams, while the average for the telegrams in transit was 8·31 words. Of the international traffic 66,766 telegrams were sent to Singapore, Penang, and places beyond, 2,065 to Australia, and 4,305 to the Island of Yap and places beyond. Telegrams received from these places were 70,155, 1,861 and 987 respectively. Of the 56,366 telegrams in transit, 28,887 were despatched *via* Singapore to Australia and 27,423 came back by the same route; 56 were sent *via* the Islands Yap and Guam. 4,128 Press telegrams, containing 221,405 words, were received from and sent to Holland, the Straits Settlements and Great Britain. The system benefited at the transit rate of 4 ct. per word on 212,133 words passing in the direction of Australia and 391 to Europe on traffic exchanged between England, France and Australia. Receipts on account of inland telegrams amounted to £45,148, while international telegrams produced £80,769, and after paying administrations and companies there remained a surplus of £23,394.

The telephones are worked by the Telegraph Department and serve the purpose of placing small places in connection with the telegraph system. There were 32 such stations, and during the year 22,140 telegrams, containing 330,872 words, were transmitted over these lines, and resulted in a net revenue of £595. Three companies own and operate the general telephone service, which brought in a revenue of £13,448. Payments to the Government, &c., in respect of rents, amounted to £10,564. Expenses in connection with the various systems are shown in one figure, and the only information to be gleaned therefrom is that the maintenance of the telegraph system cost the Government £13,284.—*Journal Télégraphique.*

Indo-China.—The system in 1905-6 owned a total mileage of wire of 27,129 km. on October 1st, 1906, this being an improvement of 1,872 km. on the previous year; 159 km. of lines in Tonkin were transferred from wooden to iron poles, and there are now 2,021 km. of wire on iron and 1,529 km. on wooden poles. Cochin China's totals are 2,164 and 503; Gamboge, 821 and 1,519; Annam, 934 and 197 respectively, while Laos owns 2,030 km. on wooden poles only. The total mileage of line on October 1st, 1906, was therefore 11,619. The official report does not give the number of telegraph offices, but it is believed that all post offices transact telegraph business, and there were 249 such offices. The *personnel* consisted of 378 Europeans and 1,180 natives. The total number of telegrams handled was 1,203,324, and they contained 47,684,058 words. The revenue for the year decreased by £9 to £19,738, which is very low considering that the rates on international telegrams were greatly reduced.

The telephone service owns 480 subscribers, who exchanged 67,742 conversations. Receipts on account of the telephone service amounted to £1,404.—*Journal Télégraphique.*

Telephony in the U.S.A.—The *Electrical World* states that the "art telephonic" has made notable progress during the past year. The total income of the industry is estimated at £40,000,000, with nearly 7,000,000 stations. The most important industrial event during the year was the abandonment of the restrictive policy of the Bell Co. as to the sale of apparatus, which formerly could not even be hired from the parent company except by a licensee. Our contemporary regards the Government purchase of the Bell system in Manitoba as an "unfortunate venture," and a most striking Socialist move, and predicts for the privately-owned telephone systems of the United States prosperous times during 1908.

Telegraphic Interruptions and Repairs:—

	Interrupted.	Repaired.
Cables.		
Curacao-Coro, Curacao-La Guayra, Curacao-Maracaibo	Closed..	Jan. 13, 1908 .. ..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Scotland-Orkney and Shetland Islands ..	Jan. 2, 1908 ..	..
Bathurst-Bissao	Dec. 25, 1907 ..	..
Paramaribo-Cayenne	Jan. 11, 1908 ..	..
Cayenne-Salinas	Jan. 14, 1908 ..	..
Teneriffe-St. Louis du Senegal	Jan. 16, 1908 ..	..
Trinidad-Demerara	Jan. 25, 1908 ..	..
Cayenne-Brazil	Jan. 27, 1908 ..	..
Landlines.		
Puerto-Barrios	Aug. 2, 1906 ..	..

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—MELBOURNE.—May 26th. Postmaster-General's department:—

(*a*) Apparatus for exchange: One common-battery switchboard, of 30 sections in all, together with all associated frames, racks, power plant and parts.

(*b*) Apparatus for subscribers' premises: 3,000 telephone wall sets; 1,000 telephone table sets; 150 extension switches (complete); 70 switchboards for two and six lines; 50 switchboards for three and 10 lines; 10 switchboards for six and 20 lines; 10 switchboards for eight and 50 lines; 200 telephone wall sets, and 100 telephone table sets for party lines.

Tenders to Deputy Postmaster-General, Melbourne. Specifications, tender forms, &c., may be obtained at the Commonwealth Offices in London, 72, Victoria Street, S.W., where also preliminary deposits on tenders may be paid. Copies may be inspected at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Battersea.—February 18th. Materials for the electricity department for one year. See "Official Notices" to-day.

Belfast.—February 4th. The Midland Railway Co. Northern Counties Committee (Ireland) require tenders for telegraph ironwork, wire, batteries, &c. Forms No. 27 may be obtained from the secretary.

Belfast.—February 22nd. Low-tension insulated V.B. cable for one year for the tramways and electricity department. See "Official Notices" to-day.

Belgium.—February 29th. The date for the receipt of tenders by the municipal authorities of Ghent for the supply and erection of 30 electrical cranes at the docks has been extended from February 3rd to February 29th.

Bermondsey.—February 17th. Stores, &c., for the Council's electricity and destructor works. See "Official Notices" January 24th.

Blackburn.—February 15th. Stores for one year for the electricity and tramways department. See "Official Notices" to-day.

Brazil.—March 5th. Tenders will be received by the Public Works Department at Rio de Janeiro from persons able to undertake the electric lighting and power supply for the Capital of Santa Catharina State. The Brazilian Government will guarantee 6 per cent. interest on the capital involved.

Bristol.—February 17th. Electric lighting installations for various buildings, &c., at Royal Edward Dock, now constructing; also supply and maintenance of cables and appliances for conveying electrical energy to the various boards at the Old and New Docks, at Avonmouth, for the Docks Committee. For full particulars see "Official Notices" January 17th.

Buenos Ayres.—May 1st. H.M. Consul at Buenos Ayres (Mr. A. C. Ross, C.B.) notifies that the municipality of that city is calling for tenders for the construction and exploitation of underground electric railways. Conditions at the offices of the Under-Secretary of Public Works of the municipality, Buenos Ayres.—*Board of Trade Journal.*

Burnley.—February 12th. Booster for the workhouse. See "Official Notices" to-day.

Castlerea.—February 22nd. Suction gas plant, gas engines, dynamos, battery, switchgear, lines, lamps, &c., for the electric lighting of the town of Ballaghaderreen for the Castlerea R.D.C. See "Official Notices" to-day.

Edinburgh.—February 10th. Extension switchboard panel for M'Donald Road electricity works. See "Official Notices" to-day.

(*Continued on page* 185.)

CURTIS TURBINES IN THE U.S.A.

ALTHOUGH in this country the Curtis type of turbine appears to make comparatively small headway compared with the Parsons type—the latter having already established itself before the former appeared on the scene—yet many very large Curtis turbine plants are in successful operation in the States. Of the earlier plants, we illustrated and described the Detroit power station with its 3,000-KW. Curtis turbines (ELECTRICAL REVIEW, July 7th, 1905), and since that time numerous 5,000-KW. units, and some of 9,000-KW. capacity of the same type, have been put into service.

Thus, the Port Morris and Yonkers power stations of the New York Central and Hudson River Railroad, which are practically duplicates, will each have ultimately an equipment of 30,000-KW. generating capacity in Curtis turbine units. The above stations have received frequent reference in the American technical Press; the buildings are brick and steel structures, the boiler houses having two facing ranges of boilers with the firing floor between and bunkers overhead.

FIG. 1.—THE 5,000-KW. CURTIS TURBINES IN THE PORT MORRIS POWER STATION.

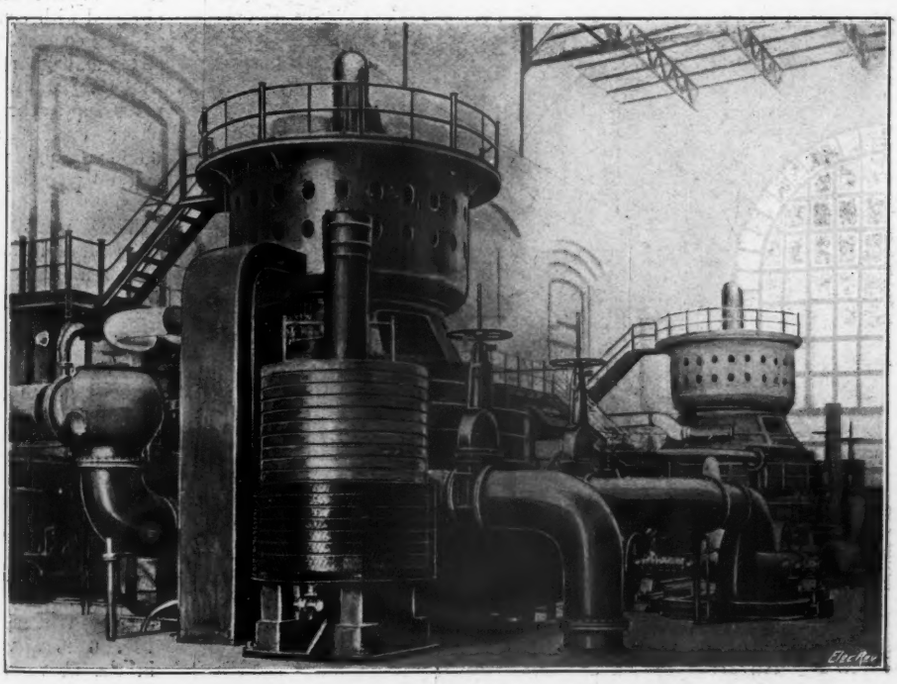


FIG. 2.—5,000-KW. CURTIS TURBINES IN THE BOSTON EDISON CO'S STATION.

Steam is supplied at a working pressure of 185 lb. per sq. in. and superheated 200° F.

In each station the present equipment consists of four 5,000-KW. Curtis turbo-alternators, each provided with its own group of steam-raising and auxiliary plant, including four boilers, one feed pump and feed heater and a complete condensing plant.

The turbines, which are shown in fig. 1, are of the five-stage type mounted on cast-iron bases which form exhaust chambers, to which the atmospheric and condenser exhaust connections are made.

The turbines embody the usual Curtis constructional features, but the condensers, which are of Worthington type, are independent of the turbines, being of the counter-

current surface type, each having 17,000 sq. ft. of cooling surface, and guaranteed to maintain a 28-in. vacuum under normal conditions.

The auxiliary plant, which is installed alonside the condensers, consists in each case of Worthington fly-wheel type

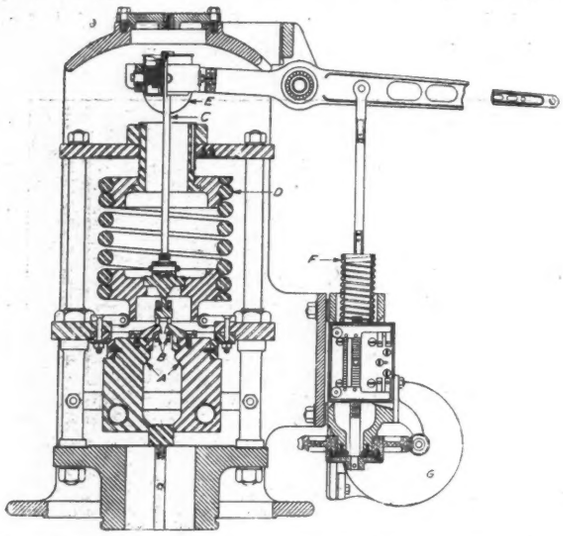


Fig. 3.—Detail of the Governor, 9,000-kw. Curtis Turbine.

steam-driven air pumps, with the air and steam cylinders arranged in tandem, also of steam-driven centrifugal circulating pumps running at 250 r.p.m.

The hot-well pumps are of the two-stage turbine type, driven direct by 10-h.p. 125-volt d.c. motors. As regards the alternators, these are of the three-phase revolving field type, generating at 11,000 volts and 25 cycles. The armatures are star-connected, with the neutrals grounded through cast-iron grid resistances to a common bus-bar. The machines, which have a guaranteed efficiency of 96 per cent. on full load and will carry momentary overloads of 100 per cent., are excited from two 150-kw. 125-volt horizontal turbo-generators, or alternatively from a battery or a 200-h p. induction motor-generator.

Another interesting plant is that of the Edison Electric Illumtg. Co.'s plant at Boston, Mass., in which two 5,000-kw. four-stage Curtis turbo-alternators have been installed, as shown in fig. 2. In this case the base of the turbine structure forms a surface condenser, with steam-driven centrifugal circulating and air pumps arranged

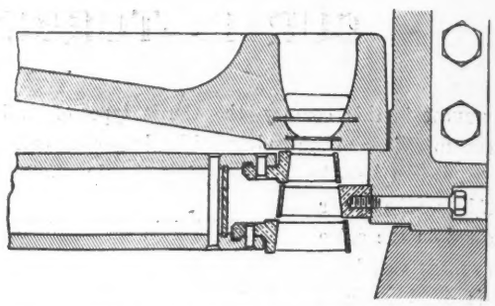


Fig. 4.—Detail of Nozzle and Buckets, One Stage, Curtis Turbine.

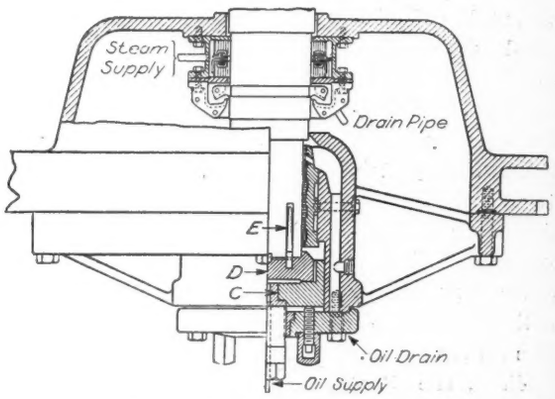


Fig. 5.—Detail of Step-bearing.

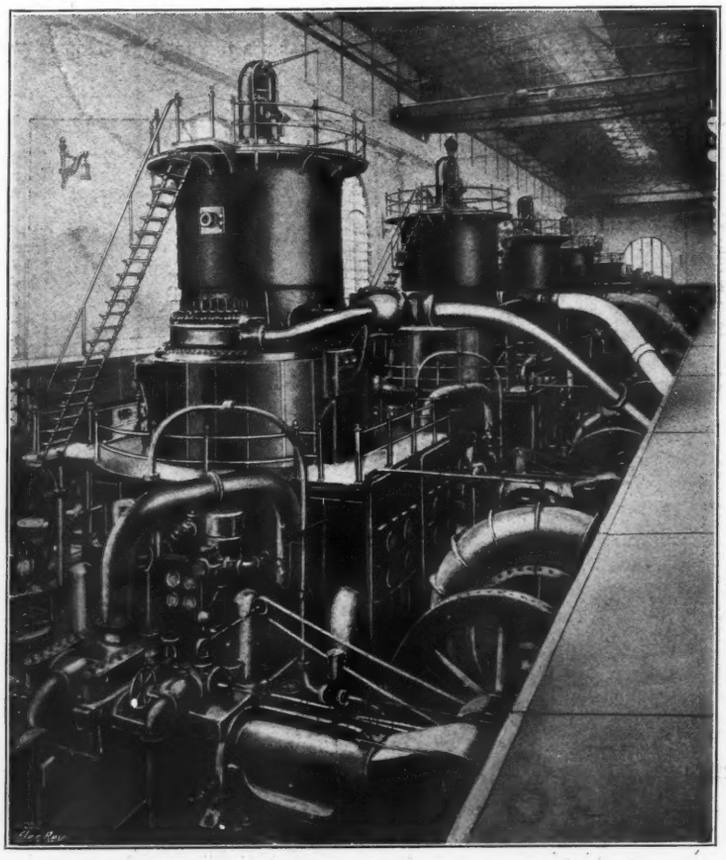


Fig. 6.—View of the 9,000-kw. Curtis Turbines in the Fisk Street Station, Commonwealth Co., Chicago.

round it. These turbines are also arranged on the unit plan, each pair being supplied with steam from eight boilers, and provided with complete condensing and auxiliary machinery. The alternators supply three-phase current at 6,600 volts pressure and 60 periods per second.

The plant is designed to include a dozen units of 5,000-kw. capacity each, and to provide a maximum overload capacity of 50 per cent. for two hours.

During the year just completed, four 9,000-kw. units have been installed in the Fisk Street Station of the Commonwealth Electric Co., of Chicago. Fig. 6 is a view in the above station, and the proportions of the large units can be gathered from fig. 7. One of these sets has been

Bruce Peebles

& Co. Limited,

ELECTRICAL ENGINEERS AND CONTRACTORS

Edinburgh

Advertising Supplement No. 9. JANUARY 1908.

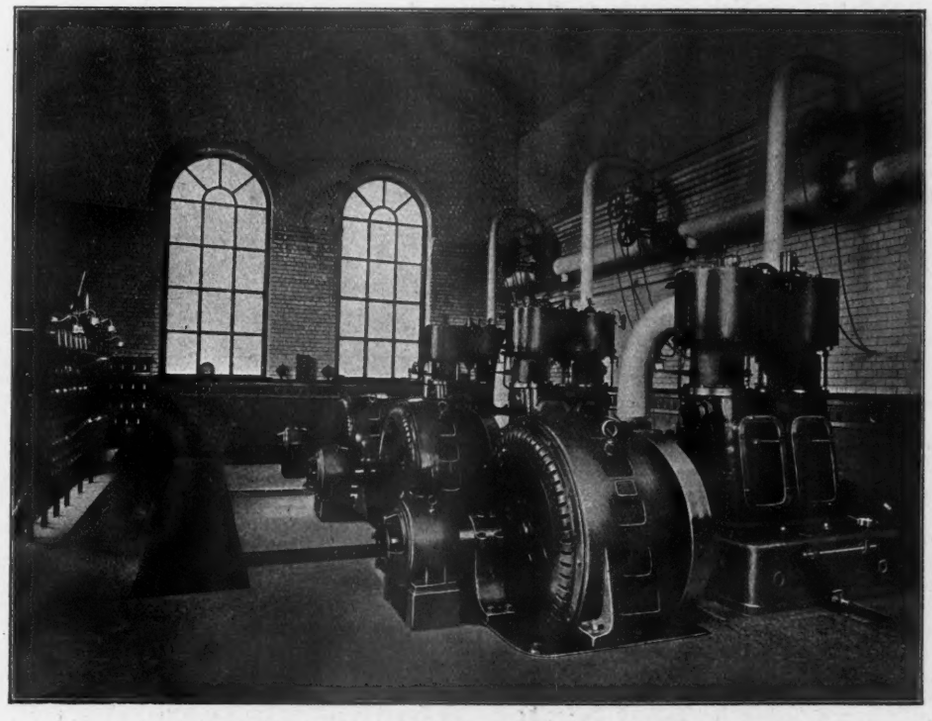


FIG. 1.—THREE 250 K.W. PEEBLES-BELLISS STEAM ALTERNATORS, SUPPLIED TO THE BRITISH ALUMINIUM CO. LTD., LARNE HARBOUR.

Alternators

THE Alternator has been rightly described as the heart of the supply system—a phrase which does no more than justice to its importance, and indicates the supreme necessity for the nearest possible approach to perfection in every part of its construction. Details make or mar the machine, and every individual detail of a Peebles Alternator is the outcome of mature consideration and experience.

Alternators

Stator

STANDARD Alternators, as listed in our new Pamphlet No. 22, are supplied with or without bed-plate and bearings, according to requirements. The Stator is a substantial but well-ventilated iron casting, free from faults or blow-holes, and cast in one piece in all but the largest sizes. The stampings, of finest core iron, are assembled without the use of through bolts, and are insulated in a special manner which has been found to reduce core losses to the minimum. Careful attention has also been devoted to the problem of ventilation, whereby the heat generated is dissipated as rapidly as possible.

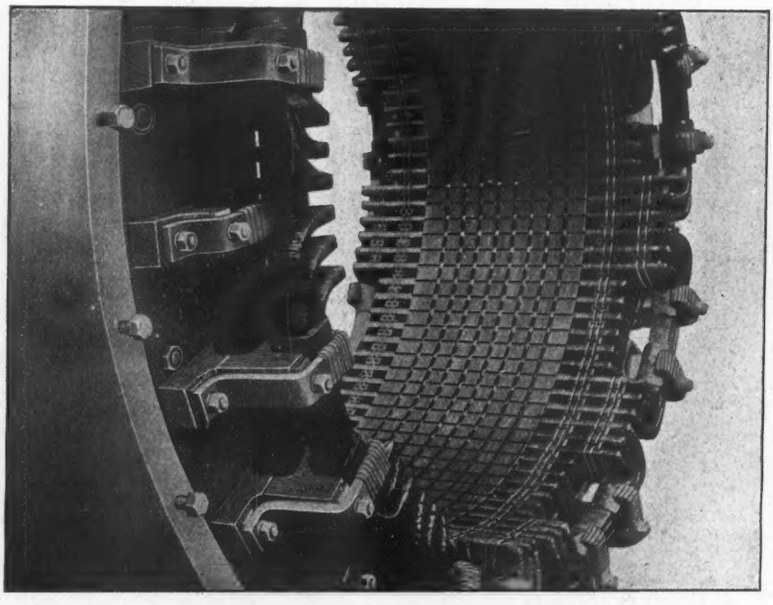


FIG. 2.—STATOR WINDING OF A 1200 K.W. 3-PHASE 6000 VOLT MACHINE, SHOWING SUPPORT OF END CONNECTIONS.

Stator Winding

THE Stator winding is formed in semi-closed slots, and is so designed in conjunction with the mechanical form and dimensions of core and field as to ensure the highest efficiency and closest regulation under all conditions. The nature of insulation used depends upon the voltage, but only the finest materials are admitted, and precautions are taken against chemical or electrolytic action. It is frequently advisable, particularly in large E.H.T. machines, that extra mechanical support should be provided for the end connections of the windings. A very thorough and satisfactory construction for this purpose is shown in Fig. 2.

Alternators

Field

THE Standard Field construction, for normal speeds, consists of a heavy steel rim shrunk on to a very rigid cast-iron spider, steel poles of oval section being securely bolted to the rim. The Field windings are of copper strip, the usual construction being shown in Fig. 3. In cases where the ampere turns per pole are relatively low, bare copper strip wound on edge is sometimes used, and this also makes a very attractive job.

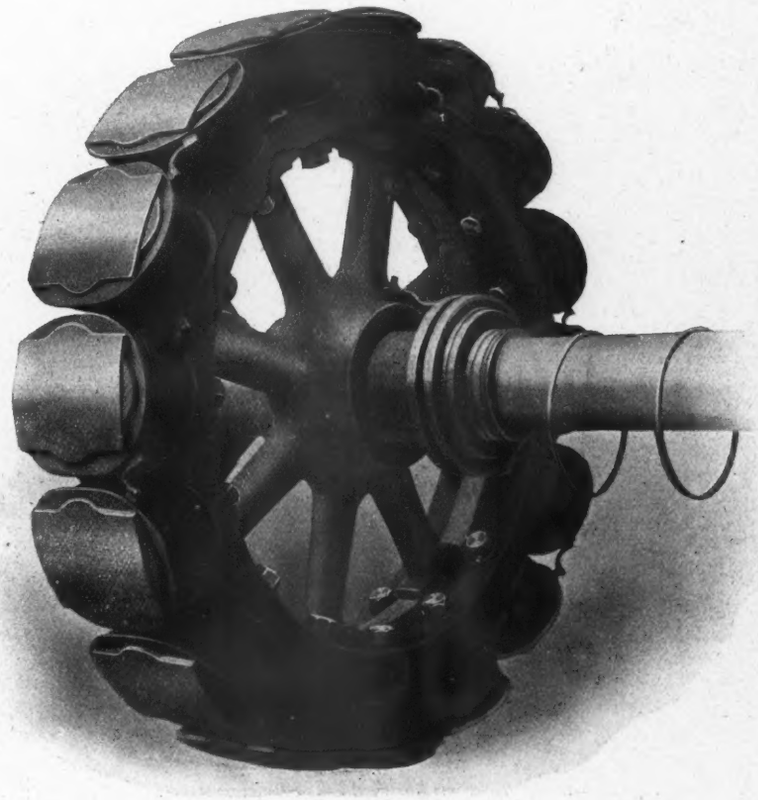


FIG. 3.—STANDARD FIELD.

Collector Gear

THE slip-rings are of gun-metal, of secret composition, and are shrunk on to a mica sleeve surrounding the slip-ring bush. The brush holders and their supports are of substantial design, and in the latest design of holder the brush pressure can be adjusted with the utmost delicacy by a thumbscrew operating a worm gear.

Bruce Peebles & Co. Ltd.

Alternators

Performance

THERE is little to choose between any of the first-class generators on the market in the matter of efficiency, but certainly no machine manufactured is more efficient than the Peebles Alternator. Further, the details are *right*, and the strength of a machine, as of a chain, being in its weakest link, this fact greatly improves the reliability and active life of the machines.

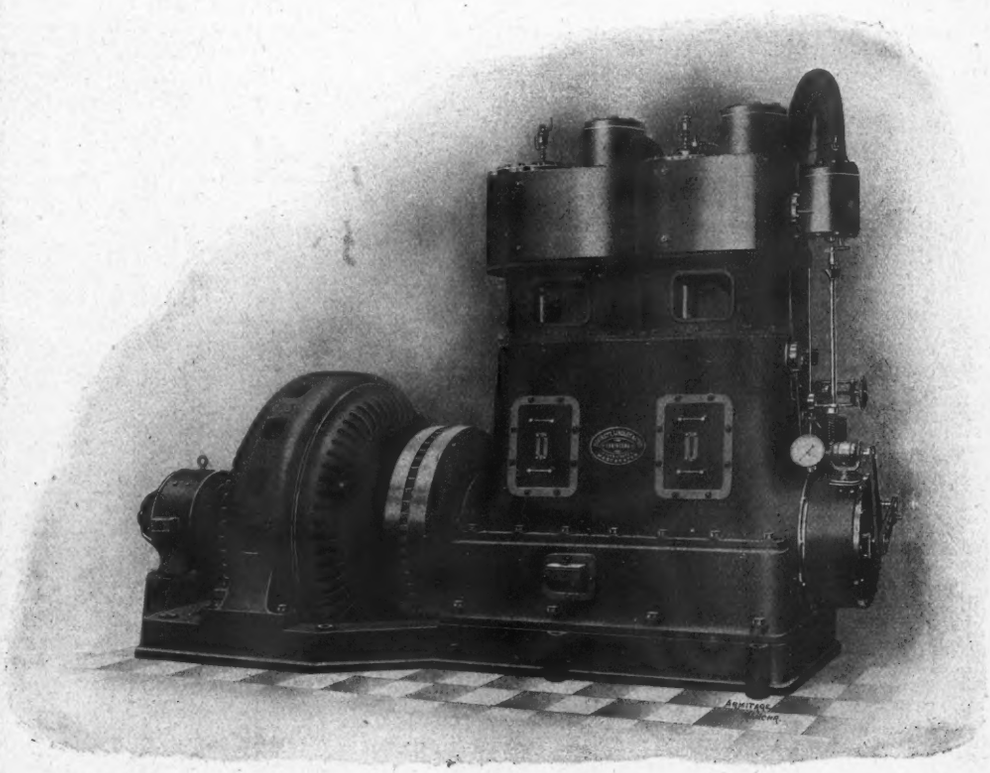


FIG. 4.—300 K.W. PEEBLES-BROWETT STEAM ALTERNATOR, SUPPLIED TO WHEAL VOR MINE, CORNWALL.

Bruce Peebles

& Co. Limited,

ELECTRICAL ENGINEERS AND CONTRACTORS.

LONDON:
1 London Wall Buildings, E.C.

MANCHESTER:
64 Cross Street.

EDINBURGH:
East Pilton Works.

SOUTH AFRICA:
Reunert & Lenz, Consolidated Buildings, Johannesburg.

CHILE AND BOLIVIA:
Martin Bros., Calle Blanco 223, Valparaiso.

SOUTH BRAZIL:
M'Lauchlan, Machado & Co., Rue de S. Pedro N. 37, Rio de Janeiro.

CHINA:
Jardine, Matheson & Co. Ltd., Shanghai and Hong-Kong.

AUSTRALIA:
F. A. M'Carty & Co., 31 Queen Street, Melbourne.

JAPAN:
L. J. Healing & Co., 22 Yamashita-Cho, Yokohama; and 86 Yedo Machi, Kobe.

Printed by WILLIAM CATE LTD., Hogarth House, Bouverie Street, and Published by the Proprietors, H. ALABASTER, GATEHOUSE & CO., at 4 Ludgate Hill, London.

Alternators

Performance

THERE is little to choose between any of the first-class generators on the market in the matter of efficiency, but certainly no machine manufactured is more efficient than the Peebles Alternator. Further, the details are *right*, and the strength of a machine, as of a chain, being in its weakest link, this fact greatly improves the reliability and active life of the machines.

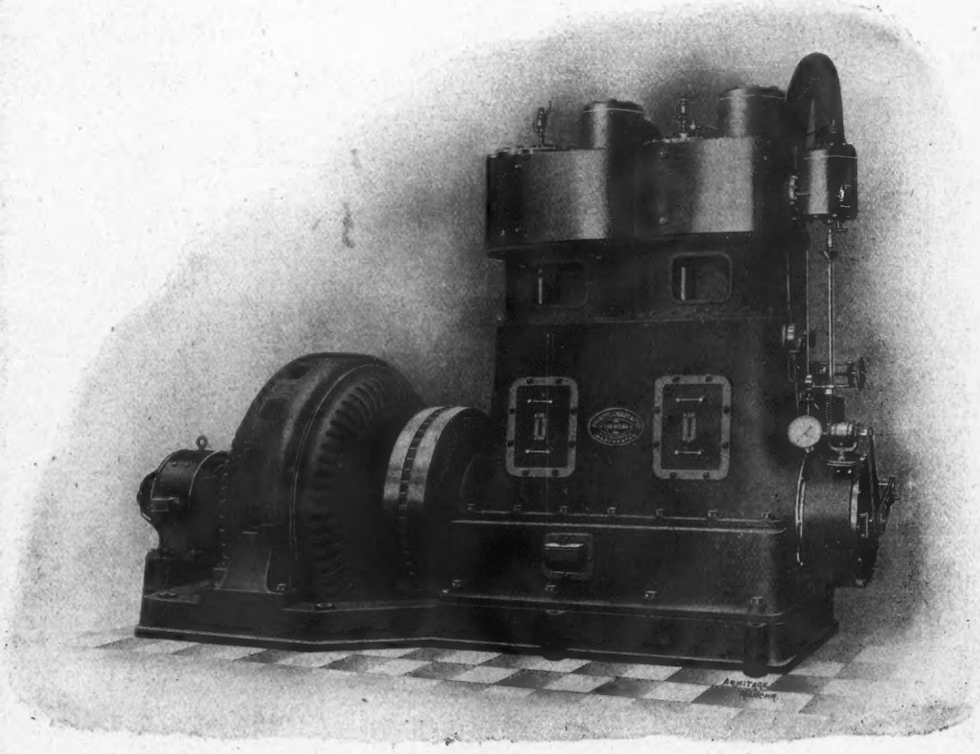


FIG. 4.—800 K.W. PEEBLES-BROWETT STEAM ALTERNATOR, SUPPLIED TO WHEAL VOR MINE, CORNWALL.

Bruce Peebles

& Co. Limited,

ELECTRICAL ENGINEERS AND CONTRACTORS.

LONDON: 1 London Wall Buildings, E.C.

MANCHESTER: 64 Cross Street.

EDINBURGH: East Pilton Works.

SOUTH AFRICA: Reunert & Lenz, Consolidated Buildings, Johannesburg.

CHILE AND BOLIVIA: Martin Bros., Calle Blanco 223, Valparaiso.

SOUTH BRAZIL: M'Lauchlan, Machado & Co., Rue de S. Pedro N. 37, Rio de Janeiro.

CHINA: Jardine, Matheson & Co. Ltd., Shanghai and Hong-Kong.

AUSTRALIA: F. A. M'Carty & Co., 31 Queen Street, Melbourne.

JAPAN: L. J. Healing & Co., 22 Yamashita-Cho, Yokohama; and 86 Yedo Machi, Kobe.

Printed by WILLIAM CATE LTD., Hogarth House, Bouverie Street, and Published by the Proprietors, H. ALABASTER, GATEHOUSE & Co., at 4 Ludgate Hill, London.

carefully tested by the owners, and the results obtained were as follows :—

Load in kw.	Steam press. in lb.	Vacuum in inches.	Superheat. Degrees F.	Lb. water per kw.-hour.
5,374	182	29·43	133	13·15
8,070	179	29·55	116	13·0
10,186	176	29·47	147	12·9
12,108	182	29·34	148	13·05
13,900	198	29·31	140	13·6

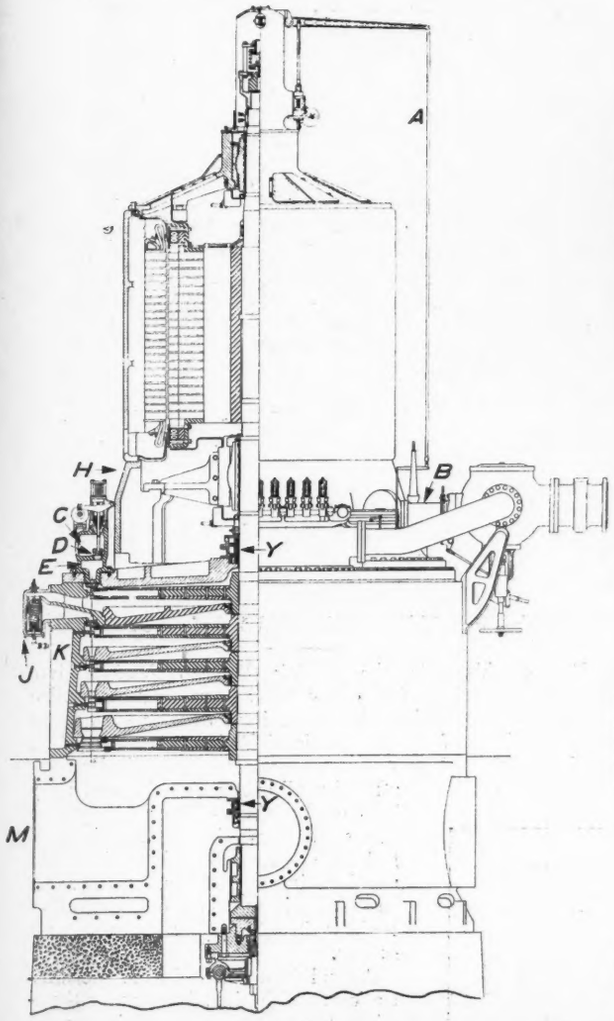


Fig. 7.—Half-section through 9,000-kw. Curtis Turbine Unit.

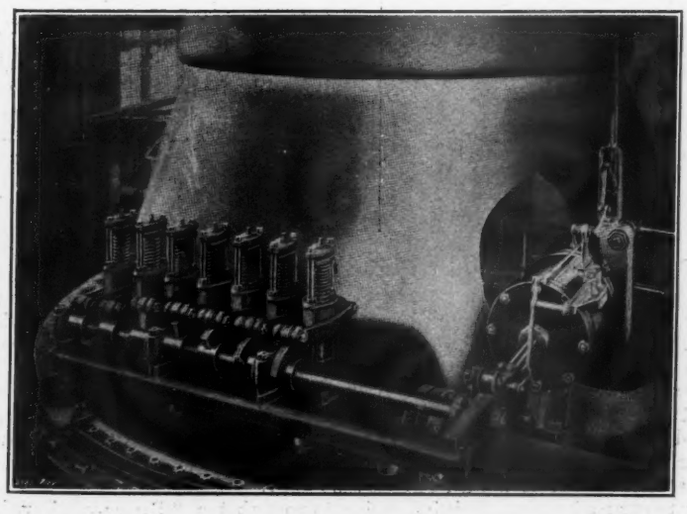


Fig. 8.—Showing the Control Cylinder, Cam Shaft and Steam Valves, 5,000-kw. Curtis Turbine.

Referring again to the fig. 7, it may be of interest to point out that there are four essential parts; the governor, the generator, the turbine, and the exhaust base.

The governor, of the centrifugal type, mounted at the apex of the machine, adjusts by means of the rod A, the movement of the piston in an oil cylinder B, the piston

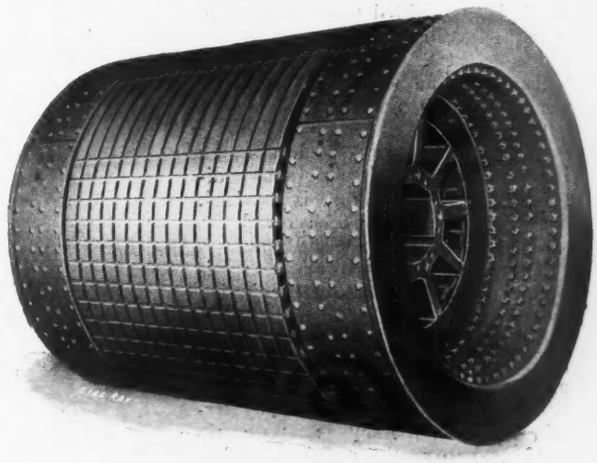


Fig. 9.—Rotor, 9,000-kw. Curtis Turbo-alternator.

rod being coupled to a cam shaft which controls the steam admission valves. The main steam pipe leads to a steam chest C, a steam admission valve being shown at D, controlling the steam supply to the passage E, leading to the first stage nozzles.

Five stages of buckets and nozzles are provided, one

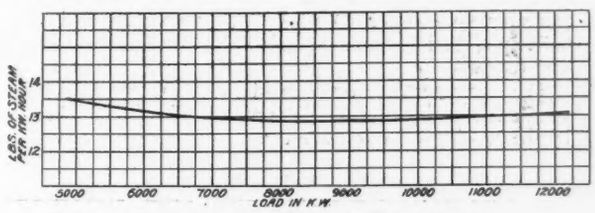


Fig. 10.—Curve showing Steam Consumption, 9,000-kw. Curtis Unit.

200 lb steam pressure; 125° F. superheat; 29 in. vacuum.

being shown in detail in fig. 4, where the upper shaded portion is the diaphragm dividing the stages and the stage nozzle and double ring of wheel buckets with intermediate fixed buckets, are shown. The axial clearances between buckets and nozzles in the first three stages are ·20 in., and in the fourth and fifth stages ·28 in. The steam finally passes into the base, and through the opening M into the condenser.

An automatic stage valve J connects the first stage to auxiliary second-stage nozzles, with a view to increasing the overload capacity by widening the steam belt.

Air and steam leakage is prevented by the use of carbon packing rings, shown at Y, these rings being practically frictionless.

The revolving element is supported by three bearings, of which the upper and middle ones are of the sleeve pattern, but the lower one, a step bearing, carries the weight of the revolving parts. A section of the step bearing is shown in fig. 5. Oil, at 600 lb. pressure, is forced between the bearing blocks C and D, and passes upwards through the steady bearing, draining back through the outer shell.

Fig. 3 shows the governor in section, in which A, the moving weight, acts through knife-edges B, on the rod C, supported by the spring D.

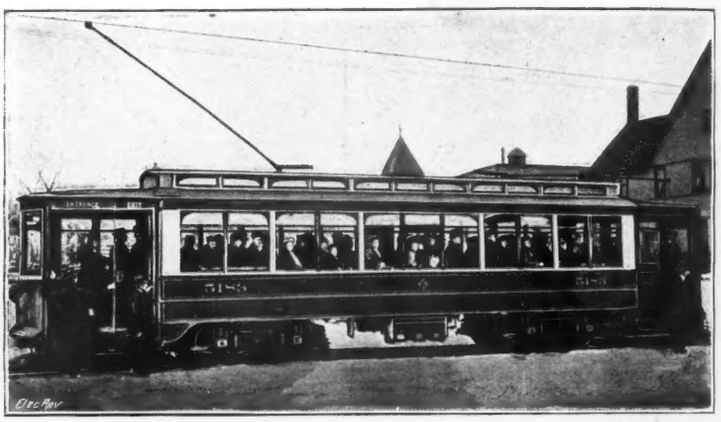
E is a ball-bearing gimbal joint, forming the junction point between the revolving portion of the turbine and the stationary lever of the governor arm. An auxiliary spring F is provided for varying the speed when synchronising, and is adjusted from the switchboard by means of the small motor G. The motion of the governor lever, as shown in fig. 7, is transmitted to the pilot valve of an oil cylinder, the piston rod of which actuates, through a rack and pinion, the cam shaft for controlling the steam valves, as shown in fig. 8.

Owing to the ease with which the turbine accelerates in speed, and the importance of limiting the speed, an additional emergency governor is provided, consisting of a ring placed round the shaft between the turbine and generator.

The ring is in a slightly eccentric position, and slides on guide-studs projecting from a collar which is clamped on to the main shaft. Speed increase causes a movement into a more eccentric position against the counteracting influence of helical springs, and at a predetermined position the ring actuates a trip motion, shutting the main stop valve. The method of balancing the rotating parts of both turbine and generator is as follows :—

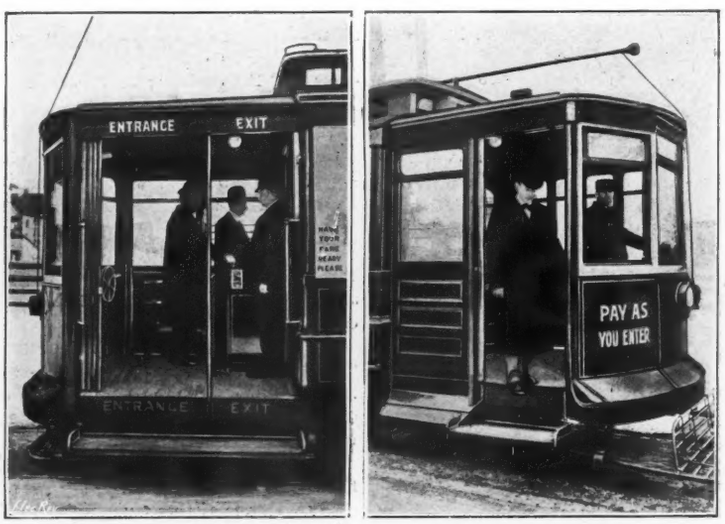
The upper and lower turbine bucket wheels are provided with threaded holes for the attachment of balance weights, openings being provided at the top and bottom of the casing through which the weighting can be effected; the generator rotor is similarly designed so that weights can be attached at its upper and lower ends. Fig. 9 shows a four-pole smooth-core rotor for a 9,000-KW. unit; the fields are built up of steel laminations, and the field coils are wound with copper strip.

The generator is entirely cased in by the stator casting, ventilation of the magnetic cores and winding being effected by the fan-like action of the rotor.



"PAY-AS-YOU-ENTER" CAR.

We are indebted to the last-named firm, and to the *Electrical World* and *The Journal of Electricity, Power and Gas*, for the particulars here given, and would remind our readers that in this country the Curtis turbine has been adopted by the Lancashire and Yorkshire Power Cos., the Liverpool Corporation Electricity Department, and the County of London Electric Supply Co., among others, in much smaller units, however, than those referred to previously.



VIEWS OF END PLATFORMS OF "PAY-AS-YOU-ENTER" CAR.

Fig. 10 shows the load water curve for a 9,000-KW. five-stage Curtis turbine, operating at 750 R P.M., with steam at 200 lb. pressure superheated 125° F., and a vacuum of 29 in.

A 5,000-KW. five-stage unit at Boston, operating under normal full load conditions, gave with a load of 5,195 KW., steam at 173·7 lb. pressure, superheated 142° F., and a vacuum of 28·8 in., a steam consumption of 13·52 lb. per KW.-hour.

In conclusion, we believe that, while the construction of the Curtis turbine is to some extent familiar to our readers through the work of the British Thomson-Houston Co., the details of the American machines here mentioned are of considerable interest.

PAY-AS-YOU-ENTER CARS IN BUFFALO.

UNDER this title the *Electric Railway Review* gives some particulars of the new Stephenson semi-convertible cars, 50 of which have been running for the last few weeks on the lines of the International Railway Co., of Buffalo, U.S.A. These cars remind us in some aspects of the Raworth "Demi-car," but are full-size, and carry both conductor and driver. They were successful from the start, and have had the effect of shortening the running time appreciably. Similar cars have been in use on the Chicago City Railway since November last, with great success.

As will be understood from the illustrations, which literally speak for themselves, the passengers pay their fares as they enter the car. Change is supposed to be obtained beforehand. The fare is deposited in a box, of which the upper part is of glass, so that the conductor can examine the coin or ticket; if it is right, he pulls a lever and allows it to drop into the box. The conductor, however, provides change if required; but even then, the passenger has to drop the fare into the box. As the conductor cannot use the fares collected for the purpose of giving change, he is provided with five pounds' worth, instead of 36s. as formerly.

It will be observed that passengers leaving the cars do so by way of a separate doorway, without mixing with and hindering those who are entering; there is also an exit at the fore end, under the control of the driver.

It is questionable whether this system of fare-collecting could be conveniently applied on our double-deck cars, but the idea of entrance at one end, and exit by the other, is worth consideration. Probably, however, it could not be worked without the former.

It is interesting to note that a "Pay-as-you-leave" car, doubtless arising out of the type here described, has been patented in America; but it does not appear to possess advantages of equal weight.

CONTRACTS OPEN.

(*Continued from page 180.*)

France.—PARIS.—February 18th. Tenders are required by the municipal sewage department for pumps worked by three-phase motors, estimated to cost £7,000. A deposit of £160 is required. Particulars may be obtained from the Municipal Council, Hotel de Ville.

PARIS.—February 18th. The Post and Telegraph department require tenders for telegraph material and apparatus (parts) for 1908 to 1910, and material, &c., for Callaud and Leclanché cells, &c. Sous Secrétariat d'Etat des Postes et des Télégraphes, Rue de Grenelle, 103, à Paris.

Germany.—February 6th. The Prussian Railways, telegraph branch, require tenders for 336,500 porcelain insulators; 77,000 metres telegraph cable; 25,000 kg. wire rope; 493,300 kg. zinced iron wire; 8,800 kg. insulated wire; 3,600 kg. copper wire, &c. Particulars may be obtained, for 1s. 6d. cash, from the Hansverwaltung, Dornhof No. 28, Cologne.

Germany.—The municipal authorities of Rosswein-in-Sa are about to invite tenders for the establishment of a central electric lighting station in the town.

Glasgow.—April 13th. Two movable bridges over the Forth and Clyde Canal for the tramways department. Particulars from Mr. J. Dalrymple, general manager.

Gravesend.—February 17th. Coal and stores for the electricity department. See "Official Notices" to-day.

Great Yarmouth.—February 1st. One 400-KW. D.C. traction steam dynamo for the Electricity Department. See "Official Notices" January 10th.

Hammersmith.—February 19th. Stores for the electricity department. See "Official Notices" to-day.

Hampstead.—February 13th. Oils for electric lighting station; removing ashes. Particulars from Borough Surveyor, Town Hall.

Hornsey.—February 17th. Electric wiring, &c., of certain buildings for the Council. See "Official Notices" January 24th.

Hull.—February 10th. Electric light installation, fittings and fans for Selby Street West School, now erecting for the Corporation Education Committee. J. H. Hirst, city architect.

Islington.—February 18th. Electrical and engineers' stores for the B.C. See "Official Notices" January 24th.

Leeds.—February 10th. Steam and exhaust piping, &c., for the Corporation E.L. department. See "Official Notices" January 24th.

Leeds.—February 21st. Sundry materials, also coal, sand, &c., for the City Tramways Committee. Also tenders for the purchase of scrap metal. J. B. Hamilton, tramway manager.

London.—L.C.C.—February 4th. Five miles of low-tension lead-covered cable, and two miles of telephone cables, &c.; also laying of ducts, &c., and reconstruction for electric traction of the tramways in Caledonian and Seven Sisters Roads for the L.C.C. See "Official Notices" January 17th.

Manchester.—February 17th. A 2-ton steam travelling crane for the Tramways Committee.

Norway.—February 7th. The Norwegian State Railways invite tenders for the supply of various telegraph material. Tenders marked "Anbud paa Telegrafmateriel," to be delivered at Styrelsen for Statsbanernes Expeditionskontor, Christiania. Copies of the specifications, &c., may be examined by British firms on application at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Norwich.—February 4th. An electric motor and other apparatus for the Corporation. Particulars from City Engineer.

Portsmouth.—February 3rd. Coal for the Tramways Committee. See "Official Notices" January 24th.

Portugal.—March 11th. The Nova de Gaya municipalities require tenders for the construction, maintenance and working of electric tramways.

Rangoon.—March 31st. The Revenue Secretary of the Burma Government will receive tenders for the concession for 30 years, renewable for a further period of 20 years, for rubber plantations at Mergui (Tenasserim).

Rathmines and Rathgar.—February 13th. Coal and other supplies for the U.D.C. electricity works. See "Official Notices" January 24th.

Rawtenstall.—February 7th. Balancing set, transformers and transforming plant, boilers, feed pumps, condensers, piping, &c., for the Corporation electricity supply department. See "Official Notices" January 24th.

Rawtenstall.—February 10th. Erection of the generating station buildings and chimney stack at Hareholme, near Waterfoot. Plans, &c., from Lacey, Sillar & Leigh, 78, King Street Manchester (deposit three guineas).

Salford.—The Tramways Committee requires tenders for electrical car accessories, &c. General Manager, 32, Blackfriars Street, Salford.

Sheffield.—February 10th. Stores for the Tramways Committee. See "Official Notices" January 24th.

Swansea.—February 21st. Motors and starting switches for the 12 months for the Corporation. See "Official Notices" to-day.

Tunbridge Wells.—February 1st. High and low-tension cables for the Electricity Department. See "Official Notices" January 17th.

Wimbledon.—February 18th. Flame arc lamp carbons for one year for the electricity department. See "Official Notices" January 17th.

Wimbledon.—February 18th. One 1,000-KW. turbo-alternator, with condensing plant; two water-tube boilers, economisers, pipe-work and feed pump; switchboard and switchboard gallery, for the Corporation electricity department. See "Official Notices" January 10th.

Wimbledon.—February 18th. Cables and conduit for the electricity department for one year. See "Official Notices" to-day.

CLOSED.

Belfast.—The Tramways and Electrical Committee on 27th inst. considered a letter received from the Harbour Commissioners requesting the formal approval of the tender of Messrs. Dick, Kerr & Co., Ltd., for the construction of the tramways and other works on the County Down side of the harbour, referred to in this column last week. The amount of the tender is £17,233, and according to the agreement with the Corporation, the work was not to exceed £19,000. The Committee recommended the tender for approval.

Bradford.—The contract for the conversion to tantalum lamp lighting at the Corporation conditioning house, consisting of between 300 and 400 lights, has been secured by Mr. Chas. Pulian.

Darlington.—Messrs. Babcock & Wilcox, Ltd., have secured the contract for the supply of boilers, &c., to Sir Theodore Fry & Co., Ltd., in connection with the electrical equipment of the Rise Carr Rolling Mills.

East Ham.—The T.C. has accepted the quotation of Callender's Cable and Construction Co., Ltd., for cable, at £224.

Finchley.—The Council received 21 tenders for one 350-KW. high-speed engine and dynamo combined, with spare parts. The lowest was that of the British Electrical Plant Co., at £2,521. The Electricity Committee, with the electrical engineer, Mr. E. Calvert, have the tenders under consideration.

Glasgow.—It is reported that the Clyde Turbine Syndicate, which has been formed with the view of developing the Corthesy turbine patent in this part of the country, has placed an order with Messrs. D. & W. Henderson, Ltd., Meadowside, for a 200-H.P. turbine for driving a dynamo.

London.—LAMBETH.—The B.C. has placed an order with the General Electric Co., Ltd., for 1,000 Osram lamps (£150) required for the new Town Hall.

BATTERSEA.—The B.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for the supply of cables, &c. (based upon 25 tons of copper, at the rate of £63 per ton), for one year, the company undertaking to maintain the whole of the cables supplied by them for a further period of 12 months.

STEPNEY.—The B.C. has received the following tenders in connection with the electricity supply undertaking:—37 street boxes—

Universal Electrical Manufacturing Co. (provisionally accepted)	£62 11 3
(Original tender £74 12s., subsequently reduced to £62 11s. 3d. by the company, in consequence of themselves having received a more favourable price for castings.)	
British Insulated & Helsby Cables, Ltd.	68 10 0
Lucy & Co., Ltd.	73 17 6
Henley's Telegraph Works Co., Ltd.	85 2 6
Richmond & Co.	117 0 0
J. Every	120 17 6
Reason Manufacturing Co., Ltd.	135 15 6
W. Cottis & Sons	143 10 0

25 large and 25 small cast-iron chambers for containing street disconnecting boxes—

E. & J. Wright (incomplete) £66 15 0 | J. Every ... (accepted) £82 10 4
J. Warner, Ltd. ... £92 10 0

MARYLEBONE.—The B.C. has accepted the tender of Messrs. Keyes, Head & Co. to paint the electric light standards in Regent Street and Oxford Street, at 25s. each.

Hammersmith.—The B.C. has received the following tenders for the construction of a sub-station in Hythe Road:—

Cowans, Ltd. ..	(accepted)	£212 15	Ferranti, Ltd. £215 8

It has accepted an offer from the Crynant Colliery Co., Ltd., for 3,000 tons of Crynant coal, at 15s. 4d. per ton. Owing to the acceptance of this quotation, the price of the 1,000 tons ordered from the company in June last is to be reduced from 16s. 10d. to 15s. 10d. per ton.

L.C.C.—The Highways Committee of the L.C.C. received the following tenders for the supply of about 500 tons of steel slot rails and 190 tons of conductor rails:—

Frodingham Iron and Steel Co. (recommended)	£5,654
Walter Scott & Co.	6,490
Steel, Peech & Tozer (incomplete tender for slot rails only)	4,462

The amount of the estimate of the Council's engineer was £5,622.

Southend-on-Sea.—The T.C. has accepted the tender of the Chloride Electrical Storage Co. for the supply of a positive battery, at £420, with £37 a year for 10 years for maintenance.

West Ham.—The Electricity Committee has extended the contract of Messrs. W. Lucy & Co., Ltd., for house cut-out boxes for two years from March 31st next, the contract price being subject to a reduction of 10 per cent. on payment of the account within seven days from the date of delivery.

Yorkshire.—The Jones-Westwood Electrical Manufacturing Co., of Leeds, are to supply a 40-H.P. dynamo and gas engine, with switchboard, &c., for the Castleford Industrial Co-Operative Society; they are also supplying motors for the Batley Co-Operative Society, Ltd.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERDARE.—40 houses at Abernant for the Abernant Building Club. A. S. Cameron, architect, 1, Glanant Street, Aberdare.

Residence at Llwydcoed for W. D. Phillips. J. Llewellyn Smith architect, Aberdare.

ABERDEEN.—New premises for the Aberdeen Hide and Tallow Co., and Slaughter House for the Aberdeen Flesher Corporation in Hutcheon Street and Fraser Road.

Addition to the works of McKinnon & Co., Spring Garden.

ARDGAY (Kincardine).—New church for United Presbyterians. A. Maitland and Sons, architects, Tain.

BAILDON (Near Shipley).—Detached residence in Station Road for A. Dickenson.

BECKENHAM.—Destructor house for the U.D.C. W. Harbrow, builder, Sidcup.

BELFAST.—New factory contemplated by Messrs. Glendinning.

New U.I.L. hall.

BIRMINGHAM.—New baths at Saltley for the T.C. (£22,000). J. Bowen and Sons, builders, Balsall Heath, Birmingham.

BISHOP AUCKLAND.—New post office. Surveyor, G.P.O., Harrogate.

BLACKHILL (Co. Durham).—New infants' school for the Durham C.C. J. J. Eltringham, architect, Derwent Street, Blackhill.

BLACKPOOL.—New warehouse in Charnley Road for the Co-operative Society, Ltd. J. P. Stopford, secretary, 44, Albert Road, Blackpool.

Important extensions to Marton Moss Schools for the managers. Rev. A. R. Burgess, 124, Harrowside, South Shore.

BLYTH.—New secondary school for Northumberland C.C. (£9,000).

BOLTON.—Alterations and improvements at St. George's Church. Bradshaw and Gass, architects, Bolton.

BOURNEMOUTH (Boscombe).—New Mission Hall in St. John's Parish (£6,000).

BRECHIN.—New offices for J. Barry, Clark Street.

BRIGHOUSE.—Refuse destructor and E.L. station for the T.C.

BRISTOL.—Enlargement of the head post office. The Secretary, H.M. Office of Works, Storey's Gate, London, S.W.

Important alterations to the old Dutch House, for the T.C. W. S. Skinner, architect, Edinburgh Chambers, 16, Baldwin Street, Bristol.

Blagdon Church to be rebuilt (£12,000). F. W. Wills, architect, Berkeley Square, Bristol; W. Cowlin & Son, builders, Shatton Street, Bristol.

BROMLEY.—Proposed new home for children. J. Ladds, architect.

BURHAM (Somerset).—Houses for W. J. Pople, A. G. Pitts and F. L. Roberts.

BURSLEM.—Business premises and offices in Morland Street for F. W. Harris. R. T. Longden, architect, Market Place, Burslem.

BURTON-ON-TRENT.—Extensions at Hoar Cross Church. Mr. Bridgeman, architect, Lichfield.

Shops and offices in Station Street for Dukes Bros.

BUXTON.—Alterations at Milton's Head Hotel, Buxton.

CAMBRIDGE.—Motor garage for C. Armstrong, The Grove, Huntingdon Road.

CHESTER.—Additions to the Corporation offices (£5,500).

CHEQUERBENT (Bolton).—Proposed new Anglican Church. Rev. H. Headley, curate-in-charge.

CLITHEROE.—New premises at Chatburn for Clitheroe Co-operative Society.

CLYDEBANK.—Reconstruction of club rooms in Kilbowie Road for the West Kilpatrick Conservative Association.

CONWAY.—Conversion of old post office into municipal offices. Borough engineer, Town Hall, Conway.

CREWE (Cheshire).—Proposed extensions premises, including putting down electric lighting and power plant for the Crewe Co-operative Society.

CROYDON.—Important additions to Waingates, London Road, for the B.G. H. Berney, architect, 104, George Street, Croydon.

DARLINGTON.—Extensive additions to the North-Eastern Railway Co.'s works.

DARTFORD.—Extensions at the Infectious Hospital for the Joint Hospital Committee (£5,000). Mr. Marchant, architect.

DENBIGH.—New school-room, caretaker's house and stable in connection with Saron C.M. Chapel. J. D. Lewis, architect, Denbigh.

DERBY.—Equipment for alternating current work in electricity at the Technical College for the T.C. (£400).

DEWSBURY.—Residence at Syke, West Ardsley. H. H. Hall, architect, Shaw Cross, near Dewsbury.

DONCASTER.—New Co-operative Stores at Brodsworth (£2,000). Mullins and Richardson, builders, Shotton Street, Doncaster.

DOVER.—Conversion of "Castlemount" into Roman Catholic College, for the Brothers of the Christian School.

DOVERCOURT (Essex).—Addition to Clifford Road Congregational Church. H. H. Packer, architect, Dovercourt, Essex.

DUBLIN.—Improvements and new block at Arbour Hill Military Hospital (£50,000).

DUDLEY.—Proposed new Town Hall and Municipal Buildings.

ECCLES.—Proposed new hotel in Trafford Road for E. Holt, brewer, Manchester; also rebuilding of old house at Home and Crown and Volunteer Inns, Eccles.

ELTHAM.—Proposed extension to Holy Trinity Church. Rev. H. A. Hall, vicar of Holy Trinity, Eltham.

EXMOUTH.—New sailors' rest in Ferry Road. H. Perry, builder.

FENNY STRATFORD (Bucks.).—New aisle and other work at St. Martin's Church. J. Chadwick, architect, Bletchley, Bucks.

GOLCAR.—Fifteen houses in Radcliffe Road for A. & T. Haigh.

GRAYS (Essex).—Kiosk on the beach for the U.D.C. E. Catton, jun., builder, Grays.

GREAT HARWOOD (Lancs.).—New mill for the Mutual Mill Building Co., Ltd.

GRIMSBY.—Model lodging-house in King Edward Street North for G. H. Hertzberg. J. J. Cresswell, architect, 77, Victoria Street, Grimsby.

HADDINGTON (N.B.).—New post office buildings in Court Street.

HELSTON.—Bungalow residence at Polurrian for Mr. Richards. H. George and Sons, Mullion, and Winn & Gooch, Helston, builders.

HINCKLEY.—Stores for Parsons, Sherwin & Co.

HOLLINS (Bury).—New spinning mill projected, to be called the "Devon."

HUDDERSFIELD.—Motor wagon works in Colne Road. E. W. Lockwood, architect, 37, Byram Arcade, Huddersfield.

HULL.—New Corporation baths in Daltry Street (£7,000).

ILFORD.—New business premises in High Road for J. Bodger. Hammond and Miles, builders, Scratton Road, Ilford.

Extension to R.C. School. Rev. Father Palmer, Ilford.

JERSEY (Channel Islands).—New post office. Secretary, H.M. Office of Works, Storey's Gate, London, S.W.

KILLINGHOLME (Lincs.).—New Wesleyan Chapel scheme under consideration. Wesleyan Chapel Committee.

KINCRAIG AND DUNKELD.—Houses for workmen for Highland Railway Co. Wm. Roberts, engineer, Inverness.

KINGSTON-ON-THAMES.—Installation of E.L. in Thatched House Lodge, Richmond Park. H.M. Office of Works, Storey's Gate, S.W.

LANCASTER.—Home for Children for the B.G. J. Parkinson, architect, 67, Church Street, Lancaster.

LAURENCEKIRK.—Building for Creamery Co. D. W. Galloway, architect, Brechin.

LEEDS (Farsley).—Houses in Whittaker Street. R. Castle & Son, architects, London, City and Midland Bank Chambers, Cleckheaton.

LEICESTER.—Alterations and additions to the Branch Library, Garendon Street. E. G. Mawbey, borough surveyor, Town Hall, Leicester.

LEIGH.—New spinning, weaving, doubling and bleaching mill, for the Leigh Manufacturing Co., Ltd.

LEITH.—Proposed new School in Links Place. Rev. D. Kilpatrick, Chairman of School Board.

LIVERPOOL.—Alterations and additions to Maternity Hospital at Walton Workhouse, for West Derby B.G. C. H. Lancaster, architect, Brougham Terrace, West Derby Road, Liverpool.

Engineering installation for new Baths for the T.C. W. R. Court, engineer, Municipal Offices, Liverpool.

LONDON (St. Pancras).—Extensions of two Schools (£16,500). Secretary to the Governors of Camden School for Girls, St. Pancras, N.W.

(Hammersmith).—Additions to Godolphin and Latymer School (£9,250). Secretary to the Governors.

(Dulwich, S.E.).—Extension of Alleyn's School (£2,500). Secretary to the Governors.

(Islington, N.).—Extension of Highbury Hill House School (£1,400). Secretary to the Governors.

(Dulwich, S.E.).—Extension of Jas. Allen's School (£4,000). Secretary to the Governors.

(Lewisham, S.E.).—Six houses and shops. Jas. Watt, Bromley Road, S.E., builder.

(Lewisham, S.E.).—Additions to Glengall Terrace, Codrington Hill. H. Blackmore, 31, Comerford Road, Brockley, S.E., builder.

(Lewisham, S.E.).—Iron church at Ladywell. W. Harbrow, South Bermondsey Station, S.E., builder.

(Westminster, S.W.).—Repairs and alterations at the Roman Catholic Cathedral Schools, Great Peter Street (£2,000).

(Hendon, N.W.).—Nine shops in North End Road. A. W. Cleaver, 54-55, London Wall, E.C., architect.

(Mill Hill, W.).—Additions to Sanatorium at Grammar School. Tribe & Co., Alperton, Wembley, builders.

(Plumstead).—Additions to building in High Street, for Max Goldstein, window glass merchant, 35, Lakedale Road, Woolwich.

(Oxford Street, W.).—Rebuilding premises for J. G. Gould & Co., chemists. Chas. Ansell, Chicheley Street, York Road, Lambeth, S.E., builder.

(W.).—Rebuilding 319, Oxford Street, for L. Collins, trunk maker, &c.

(Westminster Bridge Road, S.W.).—Premises for J. Lyons & Co., Ltd. Joseph & Smithem, 83, Queen Street, E.C., architects.

(Streatham, S.E.).—Showroom. Senecal & Co., 66, Hatton Garden, E.C., builders.

(Poplar, E.).—Roman Catholic schools in West Ferry Road. W. J. Maddison, 127, Minories, E.C., builder.

(Victoria Docks, E.).—Installation for power purposes by Odams, Ltd., Odams Wharf, manure manufacturers.

(Forest Gate, E.).—Buildings in Victoria Street, for White Bros., botanical brewers, Winchelsea Road.

(Battersea, S.W.).—Buildings in York Road, for Harvey and Thompson, Ltd., 105 and 107, York Road, Battersea, pawnbrokers and furniture dealers.

(W.).—Extensive buildings in Wimpole Street. Wm. King & Son, 3, Vauxhall Bridge Road, S.W., builders.

(Hendon, N.W.).—Development of Woodstock Estate. Hamiltons Child's Hill, N.W., agents.

(Hampstead, N.W.).—Six houses for Hampstead Tenants, Ltd., 22, Theobald's Road, E.C.

LONDON (N.W.).—Three houses in Temple Fortune Lane. Parker & Unwin, Wildes Farm, North End, N.W.

(GOLDER'S GREEN, N.W.).—Ticket office and store for Underground Electric Railways Co. of London, Ltd., Hamilton House, Victoria Embankment.

(FINCHLEY, N.).—Development of Hampstead Park Estate. Rawlins and Co., 46, Queen Victoria Street, E.C., agents.

(FINCHLEY, N.).—Two residences in Wood Grange Avenue. Moore and Nield, 20, New Bridge Street, E.C., architects.

(STREATHAM, S.E.).—Thirty houses and three motor sheds. Crunden & Co., 102, High Street, Wandsworth, S.W., builders.

(STREATHAM, S.E.).—Additions to High School for Boys. W. Mason and Sons, Streatham Common, S.W., builders.

(TOOTING, S.W.).—Confectionery works. J. Blackman, The Laurels, Albacore Crescent, Lewisham, builder.

(VAUXHALL BRIDGE ROAD, S.W.). Building on site of 252, 254 and 256. Palgrave & Co., 28, Victoria Street, S.W., architects.

(POPLAR, E.).—Alterations, &c., to R.C. Schools, Wade Street. M. Calnan & Sons, 242A, Commercial Road East, E., builders.

(STRATFORD, E.).—Laundry. W. D. Bullis, 21, Finsbury Pavement, E.C., surveyor.

(SILVERTOWN, E.).—Iron building for Suter, Hartmann & Co., Silvertown, E. Also power installation.

(WIMBLEDON).—Extension of Technical Institute (£11,400). Architect to Surrey Education Committee, County Hall, Kingston.

MANCHESTER.—Diocesan Church House, Hall, &c., in Deansgate (£40,000).

New mill in Moston Lane (50,000 to 80,000 spindles).

MIDDLESBROUGH.—New buildings for the Middlesbrough Co-operative Society at North Ormsby. Moore & Archibald, architects, 27, Albert Road, Middlesbrough.

NANTWICH.—Place of worship in Pillory Street. G. E. Bolshaw, architect, 2, Mill Street, Crewe.

NELSON.—Conversion of fish market into weaving shed for the Municipal Technical School.

NEWTON ABBOT.—Banking premises for Lloyd's Bank, Ltd. Sapcote and Sons, builders.

NORTHFLEET.—Houses in Mayfield Road for Clements & Hotter. G. E. Clay, architect, 27, King Street, Gravesend.

NOTTINGHAM.—Renovation of Nottingham Castle (£10,000).

New mess-rooms, baths, &c., for the T.C., at Eastercroft Gas Works. Gas Engineer, 6, George Street, Nottingham.

OGMORE VALE (GLAM.).—New chapel for Calvary Baptist Church, Ogmore Vale. J. Hurley, architect, 10, Bridgend Road, Aberkenfig, Glamorgan.

PARTICK (N.B.).—New church at corner of Broomhill Drive and Crow Road.

PERTH.—Extensions at Macdonald and Fraser's Auction Mart. Mr. Bell, Aberfeldy, architect.

PLYMOUTH.—Electric installation at Co-operative Society's premises, Frankfort Lane.

ROCHFORD (ESSEX).—Alterations to the workhouse (£10,000).

ROMFORD (ESSEX).—Proposed additions to the workhouse. Guardians' architect.

RUGELEY.—New station at Trent Valley for the London and North-Western Railway Co. Kirk & Randall, builders, Woolwich.

ST. HELENS.—Electric installation at the Corporation stables.

SALISBURY.—New Inn Hotel, Stapleford, to be rebuilt for Gibbs, Mew & Co., brewers, Salisbury. M. Harding, architect, 58, High Street, Salisbury.

SANDBACH (CHESHIRE).—Houses for J. R. Price, E. Venables, A. E. Wright and S. Wright.

SLOUGH.—Houses for H. Street, W. Woodhead & Son, I. Young, Dowsett and Son, N. Grove, F. Cornish and R. Cozens.

Swan Hotel, Salt Hill, to be rebuilt for Neville, Reid & Co., brewers, Windsor.

SMETHWICK.—37 houses in Grange, Waterloo and Capethorn Roads for T. Richards & Son, and 13 in Merrivale Road for G. and H. Banner.

Alterations to the Municipal Buildings.

SOUTHEND-ON-SEA.—New St. Mary's Hall in North Street. Prittlewe (£800). Mr. Deakin, architect; F. & E. Davey, builders.

Houses and shops in Hamlet Court Road for G. Smart.

Additions to Holmwood College for A. E. F. Francis.

Houses in North Avenue, Southchurch, for L. Noakes.

SOUTH SHIELDS.—Workhouse stores at West Harton for the B.G. J. H. Morton, architect, 50, King Street, South Shields.

STANHOPE (Co. DURHAM).—Extensive additions and alterations to the premises of the Stanhope and Weardale Co-operative Society. W. B. Barron, architect, 3, West View, Blackhill (Co. Durham).

STIRLING.—New station for Caledonian Railway. Mr. Matheson, engineer to company, Glasgow.

STOCKPORT.—New mill for the Spur Doubling Co.

New rectory at Norris Bank. R. B. Preston, architect; J. Padmore, Stockport, builder.

Important additions to Woodley Schools for Cheshire C.C. H. Beswick, architect, Newgate Street, Chester.

STOKE-ON-TRENT.—Old Swan Inn to be rebuilt (£1,500). A. Scrivener, architect, Hanley.

Additions to the Cottage Homes for the Stoke Guardians. Mr. Piercy, architect.

SUNDERLAND.—Branch library, Villette Road. Davidson & Cratney, architects, 22, Fawcett Street, Sunderland.

Shops and alterations 23-24, Fawcett Street. W. and T. R. Milburn, F.R.I.B.A., architects, 20, Fawcett Street.

TEDDINGTON.—Model dairy in Kingston Road for Pyke Bros.

TODMORDEN.—Restarting and renovating spinning mill and dyeworks. Messrs. Kaye, cotton spinners, &c., Oldham.

TWICKENHAM.—Eight houses and one shop. Loveless & Co., St. Margaret's Station, Thames Valley, agents.

ULABY (LINCS.).—Proposed new Wesleyan chapel (£1,300).

WAKEFIELD.—Hotel at South Kirkby for Muscroft, Ltd., brewers, Pontefract.

WALKDEN.—Additions to warehouse for Walkden Co-operative Society.

WARDLEWORTH (near ROCHDALE).—Rebuilding St. Mary's Church.

WARRINGTON.—New works at Howley. A. J. Howcroft, architect, Retiro Chambers, Waterloo Street, Oldham.

WATERLOO (near LIVERPOOL).—Houses in Picton Road and Oxford Road for J. and A. Burroughs, 8, Vernon Street, Liverpool.

WESTHOUGHTON.—Proposed memorial at St. Bartholomew's Church.

WOLVERTON (BUCKS.).—New church institute and Sunday school (£4,000).

WORSLEY (LANCS.).—Stables, &c., for Worsley Urban District Council.

FORTHCOMING EVENTS.

To-day's Events (Friday, January 31st).—At 9 p.m. Royal Institution of Great Britain. Prof. E. Rutherford, F.R.S., on "Recent Researches on Radio-Activity."

At the Hotel Cecil. Electrical Engineers' Ball.

Saturday, February 1st.—At 10.30 a.m. Institution of Electrical Engineers. Students' visit to the National Physical Laboratory.

At 7.30 p.m. Institution of Electrical Engineers (Glasgow Section). Annual smoking concert.

Monday, February 3rd.—At 7.30 p.m. Society of Engineers. Inaugural address by the president, Mr. J. W. Wilson. Presentation of premiums.

At 8 p.m. Institution of Electrical Engineers (Newcastle Section). Messrs. T. F. Wall and S. P. Smith on "Experimental Determination of the Losses in Pole Shoes, due to Armature Teeth."

Tuesday, February 4th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Section). Mr. J. S. Peck on "Protective Devices for High-Tension Transmission Circuits."

Thursday, February 6th.—At 8 p.m. At the Institution of Civil Engineers. Institution of Electrical Engineers. "Protective Devices for High-Tension Transmission Circuits," by Mr. J. S. Peck.

Friday, February 7th.—At 8 p.m. Royal United Service Institution, Whitehall. Junior Institution of Engineers. "Aerial Navigation," by Mr. H. Chatley.

At 8 p.m. Institution of Civil Engineers. Mr. P. T. Steinthal on "Electric Hardening and Annealing Furnaces."

Saturday, February 8th.—At 6.30 for 7 p.m. Junior Institution of Engineers. Hotel Cecil. Anniversary dinner.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

The following orders are issued:—

Monday, February 3rd.—"A" Company. Technical drill, 6.30 p.m.

Tuesday, February 4th.—"B" Company. Infantry drill (recruits), 6 p.m. technical drill, 7 p.m.

Wednesday, February 5th.—"A" Badge exam. for "C" and "D" Companies at 6 p.m.

Thursday, February 6th.—"C" Company. Infantry drill (recruits), 6 p.m. technical drill, 7 p.m.

Friday, February 7th.—"D" Company. Infantry drill (recruits), 6 p.m. technical drill, 7 p.m.

Saturday, February 8th.—N.C.O.'s Mess Dinner at the Café Monico at 7.15 p.m.

J. H. S. PHILLIPS, Capt.,
Acting Adjutant.

NOTES.

Late Legal Intelligence.—WEST *v.* BRISTOL TRAMWAYS CO. APPEAL.—In the King's Bench Division on Tuesday, January 28th, before Mr. Justice Phillimore and Mr. Justice Walton, the defendants' appeal against the judgment of Judge Castle in the Tolzey Court, Bristol, commenced hearing. Mr. Claude Salter, K.C., and Mr. B. R. Vachell appeared for the plaintiff, and Mr. T. Inskip was for the respondents. The plaintiff, a market gardener, of Bristol, complained that the defendants had injured his plants by paving the roadway in front of his garden with wood blocks treated with creosote. He proceeded against them for causing a nuisance, and the case was twice tried by the Recorder of Bristol and a special jury. Defendants denied the damage, and pleaded that they were protected in what they did by their statutes. Upon the first hearing the jury disagreed, and upon the second judgment was entered for plaintiff on the jury's findings. The defendants now appealed on the ground that, on the terms of their Acts, and on the findings of the jury, judgment should have been entered in their favour. The further hearing of the case was adjourned till Monday next.

Cape Colony Electric Mining Regulations.—A copy of the *Cape Government Gazette* for December 13th, containing the revised regulations for the installation and use of electricity in mines in Cape Colony, which came into force on January 1st, can be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Electric Shock Fatalities.—An inquiry was held in the Stirling Sheriff Court on 23rd inst. into the circumstances attending the death of William Smith, engineman, Cowie. The medical officer was unable, on examination, to certify the cause of death, and a post-mortem examination was equally abortive. According to a Glasgow paper, Smith was employed as an electric haulage engineman in No. 4 Polmaise Colliery, and on the morning of the accident he, with several others, was standing in the pit bottom when flashes were observed coming from the tubing which contained the electric wires. Smith put out his hand to switch off the current, but on his touching the switch he gave a cry, and fell down unconscious. He died 15 minutes later. Examination of the tubing where the sparks were said to have been seen, failed to disclose any signs of the wires having fused, and examination of the body did not show that deceased had died from electric shock, but at the same time gave no evidence of death being due to any other cause. Expert evidence was given by Mr. David Hunter, ele-

trical engineer, Glasgow, and he gave it as his opinion that the wires had not been properly earthed. Had they been, then such an accident could not have occurred. The jury found death to be due from electric shock.

The *Daily Telegraph* correspondent in Berlin says that the head of the Japanese engineering commission which is visiting Germany, a German named Schmidt, of Tokio, met with a tragic death while the commission was inspecting the power stations at Blankenese, near Hamburg. While explaining the system to his Japanese friends, Schmidt went too close to a switchboard, received a shock, and was killed instantly.

In the Francis Pit, Dysart, a miner named Combe was engaged in the underground workings, repairing the roads and covering in a piece of the electric cable. He had been driving a nail through the corrugated iron covering, and drove it into the cable. He had still a grip of the nail, with the result that he received a shock, and was killed on the spot.

The Greenwich Boiler Explosion Inquiry.—The result of the inquiry into the explosion of a thermal storage vessel at East Greenwich has now been made known. The gist of it was given in a late note in our last issue. The boiler-makers who constructed the drum are mulcted in a fine of £400, presumably because of the indentations made in the plate by the snap of the riveter when used slightly out of place in closing the plates before riveting, and their manager is fined £50. The engineers of the electrical company are fined £50 and £30 respectively for not having observed sufficient precautions, in the opinion of the Commissioners, in dealing with this high-pressure vessel after a crack had developed in an important tension plate.

Apparently the boiler insurance company were not included within the scope of the inquiry, but it is difficult to understand the reason for this, for they must have been perfectly cognisant of the construction of the drum, and they must have known that it contained no longitudinal stay, an omission that cannot but be regarded as of vital importance. It is not merely necessary that boilers should be made of good ductile plates, uninjured by the heating and working that may be put upon them during construction. Such plates must be of a form to withstand with safety the stresses to which they are subjected; and they must not only be able to withstand such stresses when the boiler is new, but they must not contain within themselves the potentiality of self-destruction. Now every plate in a steam boiler, which is not part of either a true cylinder or a true sphere, does contain the power for self-destruction, if exposed to a pressure that varies in its intensity. The plate yields to pressure and springs back by its own elasticity as the pressure is reduced: the plate breathes. In time—which may be long or short according to circumstances—a corroded groove may be set up which ultimately extends through the plate, and when grooving commences, failure has already commenced, and this it is that makes an observed crack so important a warning.

To return to the vessel which burst, it is clear that had cracking continued with a good longitudinal stay in place, the leakage would probably have become so serious that of necessity the boiler must have been stopped and the fault discovered by an internal examination; even had the plate opened out suddenly, the pressure would probably have relieved itself without doing serious or any damage. As it was, the short crack of about $2\frac{3}{4}$ in. was only an outward and visible sign of an unsuspected and extensive fissure, and it seems marvellous that the end should have held in so long as it did with so small a fraction of the section remaining.

Turning from the cause of the explosion to the effect of the inquiry, we express in our leading columns to-day our opinion as to the justice of the decision, so far as it relates to the engineers in charge of the boiler, who did all that could possibly be expected of men not endowed with the gift of prophecy.

Lancashire Electric Power Co.—There was an interesting gathering of the engineering, station and commercial staffs of this company at Radcliffe on Saturday last, where also foregathered many of the company's consumers and their electrical men-in-charge. Dinner was served to about 70 guests, and the proceedings were directed by the chief engineer and manager, Mr. C. D. Taite. Subsequently a programme of the usual felicitous and festive character was gone through, interspersed with speeches on matters affecting electrical progress and experience. Mr. Dickson, of the Westhoughton Coal Co., said he had been interested in the advent and progress of this company since its inception, and was pleased to think that its initial troubles and anxieties were now approaching the end. It was a large venture which had so far been skilfully pioneered, and gave promise of great industrial helpfulness throughout the districts where it was now operating. Though he (Mr. Dickson) was the last person who ought to say it, he trusted the L.E.P.C. would go on in a campaign which was destined to reduce the great smoke nuisance of Lancashire. He proposed "Success to the L.E.P.C. and its chief, Mr. Taite." Mr. Harris, of the Tottington Bleach Works, of Messrs. R. K. Roberts, added similar testimony, remarking that though at present they were using only some 200 to 300 electrical H.P., they had been so satisfied as to the superiority of electrical over steam equipment on every point, that every change and addition to their power would be on an electrical basis. Supply companies like the L.E.P.C. had his greatest sympathy, and he was convinced that their consumers would increase in proportion as the advantages they had to offer became thoroughly known among the power users of Lancashire.

Mr. Taite, in acknowledging, said that there had been difficulties to surmount on every hand—difficulties in technical matters, engineering matters, with municipal authorities, the Board of Trade and with private people and concerns. It had so far been their chief labour to remove these difficulties, and he was pleased to say that in a large measure they had now succeeded. In some respects their work in that area was without precedent in electrical engineering—in their system of distribution, in the equipment of their generating station with turbines, and the use of every new device and invention. The position of things at the moment was one of which they had every reason to be proud, and, indeed, they were in so advanced a position that they had now time to pause and be festive among themselves and with their friends and customers. Upon their customers they were, of course, dependent for their daily bread, but it was pleasing to have testimony on every hand that they were satisfied with what had been accomplished, and with the way in which it had been accomplished. The tendency of customers was in the direction of rapidly increasing their equipments; and so strong was that tendency that during the past 12 months the supply had increased by fully 75 per cent. If the ratio of increase was maintained, as he believed it would be, then a great success awaited the operations of his company. Eight years ago, when from his position at Southport he read that this company intended to supply current at 1d. per unit, it was considered a very absurd statement to make; but if they could now obtain that price for current he could only say the shareholders of the L.E.P.C. would be the happy recipients of big dividends. They had now to supply at little more than even half that figure for both lighting and power.

Other toasts were submitted, and speeches were delivered by Mr. John Purrett (assistant engineer), Mr. J. Turnbull (Messrs. Turnbull and Stockale, Ramsbottom), and Mr. Leach (electrical engineer for the Farnworth U.D.C.). An interesting musical programme concluded the evening's festivity.

L.C.C. Tramway Investments.—The Finance Committee, in the course of a report presented at Tuesday's meeting of the L.C.C., referred to the observations made by the district auditor on the Council's accounts for the year 1905-6. The auditor drew attention to the depreciation of the securities in the investment accounts, and suggested the desirability of showing the securities at their market value, and, in certain cases, of adjusting the accounts accordingly. In the case of the tramways renewals reserve fund, the auditor remarked that it was the usual practice in accounts relating to tramways owned by public companies to adjust the value of the investments of their reserve fund to their market value at the date to which the balance-sheet was made up, when such market value was lower than the cost, and he suggested that that course might be followed in the case of the Council's tramways. The Finance Committee stated that the investments of the fund in question consisted wholly of 3 per cent. London County Consolidated stock, and that they had always appeared in the balance-sheet at cost price. The market value on March 31st, 1906, was £2,243 less than the cost price, and the value now was less than it was at that date. It appeared to the Committee that in a case of investments of this kind a great deal depended upon the date when the investment was likely to be required to be sold. They thought there was reasonable probability of the price of first-class securities of that kind rising again before it became necessary for the Council to sell the investment. In these circumstances, it was suggested to the district auditor that the case would be met if the investment were continued at cost price, the market value being shown in an inner column, and the auditor had expressed his concurrence in the adoption of that course.

Manchester Electrical Exhibition.—We are officially informed that the Organising Committee is now complete, with Councillor Kay, J.P., of Manchester, as its chairman, and Councillor Barrett, J.P., of Salford, as deputy chairman. At a meeting held on 20th inst., a report was given by the secretary showing the position of the scheme up to date, and it was resolved to proceed with the necessary arrangements for holding the exhibition in Manchester in October next. An Executive Committee was appointed, so that matters might be promptly dealt with, its members being:—The chairman and deputy-chairman, the consulting engineers (Messrs. Pearce and McCowen), Messrs. H. Berry, H. Bevis, D. N. Dunlop, F. Nalder, C. D. Taite and H. Talbot. A meeting of this Committee was to be held on Monday last at the offices, 2, Queen Anne's Gate, S.W., to consider arrangements for site, buildings, &c. It is intended shortly to issue a preliminary circular to the trade inquiring as to space requirements, and in designing the buildings, provision will be made for their easy extension up to within three months of the date of opening. The Executive Committee was instructed to enter into agreements with Messrs. Northcote and Davenport.

Proposed Engineering Employers' Association for Coventry.—The *Birmingham Daily Post* says that a movement is on foot to organise an Employers' Association for the engineering trade in Coventry and district. The objects are set forth as being "broadly to secure mutual action in dealing with matters of common interest," and having "particular application to dealings with Trade Unions and the terms of employment of labour." Twenty firms have expressed their intention to join the association. The scheme has been the subject of some criticism in local labour quarters, where it is described as "a compact to smash up trade unions."

Annual Dinner.—The staff of the electrical department of the North Staffordshire Railway Co. recently celebrated their eleventh annual dinner at the Copeland Arms Hotel. The electrical engineer, Mr. Andrew F. Rock, took the chair.

Institution and Lecture Notes.—THE JUNIOR INSTITUTION OF ENGINEERS.—On Saturday, 11th inst., by permission of Mr. Fitzmaurice, chief engineer to the London County Council, an inspection was made of the reconstruction work in progress in Stockwell Road, the members being shown over by the resident engineer, Mr. Alex. Millar, and Mr. Fitz Roy Roose. The members, conducted by Mr. J. Bowden, rolling stock superintendent, afterwards proceeded by one of the latest types of cars to the sheds at Clapham High Street, and inspected the motor school where the drivers are instructed in the manipulation and operation of the controllers, brakes, &c., and the sub-station containing three motor-generators. At the ensuing meeting of the Institution on February 7th the subject of "Aerial Navigation" is to be discussed, some of the leading authorities in France and England being expected to take part.

ROYAL SOCIETY.—Among the papers to be read yesterday were the following:—

"On the Non-periodic or Residual Motion of Water moving in Stationary Waves." By Mrs. Ayrton. Communicated by Prof. J. H. Poynting, F.R.S.
"The Refractive Index and Dispersion of Light in Argon and Helium." By W. Burton. Communicated by Prof. J. J. Thomson, F.R.S.
"On the Generation of a Luminous Glow in an Exhausted Receiver Moving near an Electrostatic Field, and the Action of a Magnetic Field on the Glow so Produced." By Rev. F. J. Jervis-Smith, F.R.S.

Appointments Vacant.—Sales engineer for the Hackney Electricity Department (£150); shift engineer for Crewe (£80).

A Rogue.—The little town of Fethard, Co. Tipperary, has been bitten badly by a gentleman named Henry Robert Haines, who cut a great dash for a while at offices in Dublin's best street, but left hurriedly on business in a distant country one of the days recently. It appears, too, that he omitted to notify his creditors of his changed address. This worthy man combined the professions of consulting engineer, broker and commission agent, which some of us might consider an illegitimate combination.

The "report" which he submitted to the Fethard Power Commissioners is an instructive document, and is one which might be filed by any other consulting engineers who do their own contracting, and make their profit by not paying for materials. Mr. Haines's letter, written from 51, Grafton Street, Dublin, under date October 7th, 1907, and bearing at the top some printed matter, apparently in the Spanish language, is addressed to Mr. Richard McCarthy, chairman of the Town Commissioners:—

"Dear Sir,—*Re* electric lighting of your township, I have now gone carefully into this matter, and have now to say that in my opinion the most efficient and economical results will be obtained from the following installation:—Six arc lamps, 28 Osram lamps, the arcs to be placed in the positions indicated, and the Osram's to be run in series, two each of 14 volts, in such positions as you might desire. You would thus have a much more brilliant illumination than hitherto, and possess lamps with longer life than any yet invented. The annual charge for supplying power for this installation will be £60, and the cost of installing £28. The Osram lamps will be £21. As an alternative you can have the following:—Six arc lamps, six Nernst lamps, eight 16-c.p. lamps. The annual charge for which will be £56, and the cost of installing all the extra lights will be £12."

"A special meeting of the Commissioners was held on October 11th, at which Mr. Haines attended, and it was decided that he get £52 10s. per year, which Mr. Haines agreed to.

"Since then Mr. Haines has disappeared, under circumstances already well known, and his electric installation in its crude and unfinished state is a matter for comment to everybody visiting the town. Some of those who were originally associated with him are temporarily carrying on the lighting of the town."—*Tipperary Champion.*

We understand that Mr. Haines advertised for pupils, and sent the crop to Fethard, where we presume they have been learning to erect arc lamp poles. It is said also that Mr. Haines received a premium from a typewriter for teaching her to become a specialist. We do not quarrel with that, because we can quite believe that the nature of Mr. Haines's business was extra special.

Refrigeration Congress.—We are informed that the first International Congress of the Refrigerating Industries is to be held in the Grand Palais des Champs Elysées, Paris, from July 13th to 18th. The London offices are at 3, Oxford Court, Cannon Street, E.C.

Engineering Science at Oxford.—According to the *Times* "University Intelligence," there will be an election to the Professorship of Engineering Science in April next. Candidates are requested to send applications and evidence of qualifications to the Registrar of the University, Old Clarendon Building, Oxford, by March 14th. The Professor will be elected for a period of five years, but will be re-eligible. He will receive £600 per annum from the University chest. He will also be elected to a Fellowship at New College, and will receive the emoluments of the Fellowship, £200 per annum. It will be the duty of the Professor to lecture and give laboratory instruction in the subjects of engineering science. He will also take charge of any engineering laboratory which may be assigned to him by the University.

Another American Receivership.—The Chicago and Milwaukee Electric Railroad was mentioned in connection with a receivership in the earlier days of the American financial trouble. It is not surprising, therefore, to hear, says the *Pall Mall Gazette*, that Judge Grosscup, of the U.S. Court, has appointed a receiver for the railroad. The application is said to be on behalf of interests favourable to the present management. The company was incorporated in 1902. It operates 186 miles of double track.

Franco-British Exhibition.—We are informed that a trade meeting connected with the British electrical section at the above exhibition, was held at the Institution of Electrical Engineers on Tuesday afternoon, when it was unanimously resolved to proceed with the scheme, and an Executive Committee was elected representing the Institution, the London Supply Companies, and the exhibitors.

The French Government laid before the Chamber a Bill providing for a grant of 795,800 fr. (£31,832) for the cost of participation of the public services in this Exhibition, and for subventions to some groups of exhibitors.

The Electrical Contractors' Association (Inc.).—The seventh annual dinner is to be held on Monday, February 17th. Any member of the allied branches of the trade can obtain tickets from Mr. E. J. Hogan, 102, Charing Cross Road, W.C. (8s. 6d. each).

The Electro-Harmonic Society.—We are informed that in consequence of the non-completion of the new St. James's Hall, the "Ladies' Night" Concert, on Friday, February 21st, will be held at the Bechstein Hall, Wigmore Street.

Exhibition.—A Municipal, Building and Public Health Exhibition is to be held at the Agricultural Hall, London, from May 1st to 12th. Messrs. Smith and Bridges are the organising managers.

For Sale.—Acton U.D.C. is inviting tenders for the purchase of two 140 KW. motor-generator sets. See an "Official Notice" in this issue.

Fire at Salford.—Between 5 and 6 a.m. on January 21st a fire which is said to have originated in the boiler-house, gutted the three-storied building of Messrs. Cowans, Ltd., in Springfield Lane, Salford. We are informed that arrangements are being made immediately for the carrying out of contracts and orders in hand, to avoid delay. The registered address of the company is at the present time 62, Lancaster Avenue, Fennell Street, Manchester, and all communications should be sent there.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—On leaving the Sunderland Corporation electrical department to take up a position under the Cleveland and Durham Electric Supply Co., Ltd., MR. D. E. BELL has been presented by the staff with a gold watch and cigarette case.

MR. J. W. FARRELL, of Manchester, has been appointed mains foreman under the Birmingham electric supply department. Mr. Farrell was mains and installation foreman under the Stalybridge, Hyde, Mossfield, &c., Joint Board.

MR. W. C. HOPKINS, of Redditch, has been appointed meter reader and collector at Grantham.

MR. A. BLACK has resigned his position as senior shift engineer at the Aberdeen Corporation electricity works.

Tramway Officials.—MR. CAIRD, who has been appointed tramway traffic superintendent at Halifax, has been presented by the staff of the Aberdeen Tramways with a silver tea service.

General.—The staff of the National Telephone Co. at TRURO have presented a smoker's cabinet to MR. CHAS. FFRENCH, who has been appointed manager of the Barnstaple district.

MR. HARRY WHALLEY, B.Sc., of Burnley, has been appointed junior assistant at the electrical engineering and physical science department at the Harris Institute, Preston.

MR. J. W. BESWICK has resigned his position with the Salford Corporation Electricity Department, to take up an appointment with Messrs. F. Hutchins & Co., Ltd., Harlesden.

MR. GEORGE MORGAN, Assistant Controller, has been appointed Controller of Postal and Telegraph Stores in the place of Mr. S. C. Hooley, who recently retired.

Obituary.—COLEMAN SELLERS.—Our American exchanges record the death of Dr. Coleman Sellers in his 81st year. To his very extensive work in the sphere of mechanical engineering we need not refer, for it was his connection with the harnessing of Niagara Falls, nearly twenty years ago, that brought his name before British electrical engineers. Of his share in this important undertaking, one of our New York contemporaries says:—"He was called upon, in 1889, by several capitalists to consider the practicability of generating electricity by water-power at Niagara Falls for the transmission of electrical power to Buffalo. He reported favourably on the project, and upon his advice the enterprise was undertaken. He represented America on the International Niagara Commission of five members, which, with Lord Kelvin, then Sir William Thomson, as chairman, was established in London in 1890. He acted as engineering head of the work, both as consulting engineer of the Cataract Construction Co. and chief engineer of the Niagara Falls Power Co., serving also as chief mechanical engineer of the

Canadian Niagara Power Co. Dr. Sellers devoted his wide experience to the solving of the many problems presented by the novel character and magnitude of the undertaking, the important mechanical features of the great dynamos being of his design and invention."

CITY NOTES.

British Aluminium Co., Ltd.

Mr. J. D. Bonner (chairman) presided on Thursday, January 23rd, at Winchester House, Old Broad Street, over an extraordinary general meeting of the above company for the purpose of considering the following resolution:—

(a) That each of the £10 conversion shares (created in 1906) in the company's capital be divided into two shares of £5 each, one of which shares shall be a 7 per cent. preference share entitling the holder thereof to participate in the profits of the company as from January 1st, 1908, and ranking in all other respects *pari passu* with the existing 7 per cent. preference shares of the company, and the other shall be an ordinary share entitling the holder thereof to participate in the profits as from the same date and ranking in all other respects *pari passu* with the existing ordinary shares of the company.

(b) That the shares resulting from the division of each of the existing £10 conversion shares be renumbered consecutively with the existing 7 per cent. preference shares and ordinary shares respectively.

(c) That, as regards such of the £10 conversion shares as are not fully paid up, the proportion between the amount which is paid and the amount which is unpaid on each share of reduced amount shall be the same as it was in the case of the existing share of £10 from which the shares of reduced amount are derived.

The Chairman, in moving the adoption of the resolution, said that in the ordinary way he would only have referred to the question before them, but so many shareholders had become perturbed at the serious fall in the company's shares that he had decided to depart from the usual course and give a great deal of information which in the usual way would be communicated in the spring. They were all, no doubt, aware of the demoralisation of the metal markets of the world last summer, consequent on the slump in copper, and the serious fall in metal prices generally, which brought to an abrupt termination their little boom in aluminium. Notwithstanding, it was estimated that their profits in 1907 would not fall materially below the £153,000 which they made in the previous year. They brought forward over £34,000 from 1906, so that they would have a very large disposable balance. It was their intention to deal with this upon the same conservative lines that they had proceeded upon in recent years, and after making a large appropriation to reserve fund, &c., and paying 7 per cent. upon their ordinary shares, to carry forward an amount somewhere in the neighbourhood of £50,000. They expected this year, now that they had started producing at the works at Leven and at the Norwegian works, to produce about twice as much aluminium as they did last year. Although the price was at present only about £100, yet, if they succeeded in disposing of the whole of the increased production, which he was hopeful of doing, there should not be any material shrinkage in their profits, especially as some increase could be confidently counted upon for their investments. At all events, they had a larger tonnage of aluminium sold for forward delivery than ever before. They had just appointed Mr. A. Jacob secretary of the company, and he would in future be in charge of the selling arrangements. Mr. Jacob was a member of the Institution of Electrical Engineers, and would particularly direct his attention to extending their sale of aluminium for electrical purposes, which was perhaps the chief of the many new openings for the metal at the reduced price. They had also strengthened the commercial side of the board by the appointment of Mr. A. J. Sharwood as a director, who would actively associate himself with Mr. Sawyer and himself (the chairman) in the management. On the other hand, they had suffered an irreparable loss by the death of Lord Kelvin. Lord Kelvin was always keenly interested in the aluminium industry, and rendered eminent services in connection with its introduction by the company into this country. They who had been associated with him in its development and had had the benefit of his splendid intellect, could not but regret that they would lose the advantage of his guidance. Fortunately Mr. Morrison, with Lord Kelvin's full approval, became technical adviser jointly when Lord Kelvin was still with them. Their company was not merely an aluminium and manufacturing company, but was also a great power company, which in almost the immediate future, when all their great power schemes were completely developed, would have at its command something like 60,000 H.P. They had had the advantage of their Foyers power for some years. Their Norwegian power was not so important, but it was a very cheap one. Mr. Sawyer would give them some details of the Orsières undertaking. The Leven power, which was their largest, was, on account of its uniformity and location, one of the finest powers in the world. At Loch Leven they were building what was practically a small harbour, so that steamers of large tonnage could be able to approach at all times to within a few hundred yards of the works. Cheap freights were thus assured for all materials required, as well as for the material produced. They were also proceeding with the building of a village to give accommodation for 6,000 to 8,000 people, who would be necessary for the utilisation of the power. They had a very valuable asset at Leven, and were looking forward to the time when the large sum which they had expended upon it became productive, for they were not even taking credit for the interest during the constructive period, although authorised to do so under their Parliamentary powers. The scheme was costing materially more than they originally anticipated, and was taking longer to finish. This had caused great disappointment to the directors, as they had to promote a Bill in this session of Parliament for an extension of time to complete the works. A year ago he mentioned that they were quite alive to the possibility of the demand for the prices for aluminium proving insufficient to warrant their employing in its production the whole of the power they had in prospect when it first became available. At any rate, for some years they would have to utilise the Orsières power for other production, and at the present time negotiations with a Continental electro-chemical company were in progress for that end. Entertaining, as they all did, a very confident opinion as to the steadily increasing value of water power, they could rest assured that they would not conclude any arrangement for the utilisation of power over any considerable period unless they were satisfied that it was to their advantage to do so. They would be prepared to hear that, in consequence of the large expenditure they incurred, they would want more money; but they still had over £300,000 to receive in respect of their last issue of conversion shares. They would, however, take advantage of any favourable opportunity to issue the £200,000 6 per cent. preference shares they agreed to last spring; these formed part of a total issue of £300,000 6 per cent. preference shares, of which £100,000 were placed some years ago, and they had behind them £1,000,000 of junior capital. Any other capital required would be raised by rearranging and enlarging the debenture debt. Approximately, when their works were finished their debenture debt and capital would stand at just over £2,000,000, the greater part of which was yet to become profit-earning. They would not only have this 60,000 H.P., but other assets of great value. They owned the estate and village of Foyers, the village of Leven, their valuable and important French Bauxite investment, their carbon works and aluminium works at Larne, which cost over £100,000, and their large rolling mills in Staffordshire, which, owing to increasing demands for sheets and other manufactured products, they were compelled to still further enlarge. The only intangible asset in their balance-sheet was goodwill, which had been reduced to £93,000 and which would be further reducible by the last year's profits, and would be gradually wiped out altogether. Their assets were not only valuable, but they might be counted upon to yield an income sufficient to assure them very substantial dividends. Now that the advantages of water power were so generally recognised, it could be let at remunerative rates for many purposes, although their expectation was that they would obtain the most satisfactory results by utilising the power themselves.

Mr. Sawyer seconded the motion, and said that the Orsières works would probably be completed at the end of next year.

The resolutions were carried.

Metropolitan Railway Co.

The report of the directors for the half-year ended December 31st, 1907, states that the total receipts (deducting this company's proportion of the revenue of the City lines and extensions) have been £347,651, and the expenses £191,959, leaving a profit of £155,692. Compared with the corresponding half-year of 1906, the receipts show an increase of £3,776, and the expenses a decrease of £5,914. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges, and the dividend upon the preference stocks, and placing £6,000 to the depreciation fund, shows a balance of £19,846 available for dividend upon the ordinary stock. A dividend upon the ordinary stock for the past half-year at the rate of 10s. per cent. per annum is recommended, carrying forward the balance of £5,516. The Surplus Lands Committee announce that the dividend on the surplus lands stock will be at the rate of £2 15s. per cent. per annum. This is the first occasion since the agreement with the Great Central Co. came into force that it has been possible to make a comparison in the accounts with the corresponding half-year, and the directors show both an increase in the receipts, which has been continuous throughout the half-year, and a reduction in the expenditure. The extra revenue has been earned in spite of very keen competition. To meet this competition a largely-increased service of trains has been run, the electrical working now in full operation having rendered this extra service possible without materially adding to the expenses. A conference was formed a short time ago of representatives of the various passenger-carrying companies in London with a view to limiting competition, adjusting fares, arranging through bookings, &c. It is hoped in this way to help the interests of the companies concerned and at the same time to give increased travelling facilities to the public. All the electric underground lines likely to be made are now open, and it is possible to gauge the effect they may have upon this company by diversion of traffic. On certain routes the loss has been considerable, but the extra accommodation which all these lines afford has induced a large increase in the travelling habit of the people of London which will, no doubt, further grow; and the directors have every reason to think that any loss incurred on particular routes will soon be balanced by gains in other directions. The result on the traffic of the electrification of the Hammersmith and City line and its extension to Addison Road has been satisfactory, and an appreciable increase is shown in the business in consequence. In conjunction with the Great Western Co., who are partners in the line, it has been arranged to build a special station where the railway abuts on the site of the Franco-British Exhibition, with an entrance directly into the exhibition grounds; from this it is expected that a large business will result during the ensuing summer. During the half-year two accidents have happened—one at West Hampstead, and the other at Farringdon Street; to meet the expenses arising from them it is proposed to take £4,500 from the reserve fund. In

consequence of failing health, Colonel Mellor has felt compelled to retire from the board after having been associated with the company for twenty years. Mr. Thomas Parker, M.I.C.E, under whose direction the electrification of the line was carried out, has been elected to fill the vacancy. The directors are not promoting a Bill in Parliament next session. The dividends are to be payable on February 4th. The figures as to traffic and receipts during the last four years are as follows:—

Year.	Number of passengers.	Gross receipts for passengers, goods, minerals and tolls.
1904	94,436,438 ..	£831,221
1905	95,634,616 ..	832,034
1906	98,384,766 ..	681,268
1907	96,859,108 ..	640,838

TRAIN MILEAGE.

Half-year ended Dec. 31st, 1906.		Half-year ended Dec. 31st, 1907.
523,583 ..	Steam passenger trains	150,167
825,897 ..	Electric passenger trains	1,545,149
96,758 ..	Goods and mineral trains	102,644
1,446,238 ..	Total	1,797,960

The meeting was held on Wednesday. Our report of the proceedings will appear next week.

British Electric Traction Co., Ltd.

THE directors have sent out the following important circular to the shareholders:—"The directors have had under consideration the question of the payment of the half-yearly dividend on the 6 per cent. cumulative preference shares of the company on February 15th next, and the majority of the directors are of opinion that this dividend should be paid, but the two directors who joined the board last year are of opinion, having regard particularly to the present depreciation of some of the company's investments, that the available profits should not now be distributed. In these circumstances the directors, in order to avoid disunion of the board, which would be prejudicial to the interests of the company, have agreed to the settlement of this question being postponed until the general meeting of the company, which will be held as soon as the accounts for the year ending March 31st next can be presented. The directors have had an estimate prepared of the profits for the year. It shows:—

Dividends and interest on shares, debentures and consols ..		£153,000
Interest on loans, &c.		7,200
Net profit on working sundry undertakings		5,500
Sundry profits on contracts, &c.		14,000
Net profit on sale of investments		20,000
Balance of Bombay profits		41,900
		£241,600
From which must be deducted:—		
General and sundry expenses	£24,000	
Sundry losses and provisions	12,000	
		36,000
		£205,600
The interest for the year on the first and second debenture stocks amounts to	£97,484	
And the interim dividend paid on the preference shares from April 1st to August 15th last, to	36,754	
		134,238
		£71,362
To which must be added the balance brought forward from last year of		13,115
Leaving		£84,477
Available for further dividends, and the company has cash in hand to approximately this amount. The half-year's dividend on the preference shares to February 15th requires		£48,481

The whole of the profits of the year will be realised in cash, with the exception of the Bombay profits, and with regard to these it may be stated that the ordinary shares of the Bombay company are marketable at or above par."

[The two new directors elected at the last annual meeting were the Right Hon. H. O. Arnold-Forster, M.P., and Mr. P. D. Tuckett.]

Direct United States Cable Co.

THE meeting of this company was held on Tuesday at Winchester House, Mr. E. M. Underdown, K.C., presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, January 24th, p. 147) said that with regard to the revenue, as compared with the same period last year, there was a small falling off of £2,111, which took place during the months of August and September. That small decrease could be explained with very little difficulty. The shareholders were aware of the complications which had occurred on the other side of the Atlantic, and although whatever happened there that was of interest must find its way across the ocean, and consequently over the telegraphic cables, the company infinitely preferred the steady business which they secured when matters were in a prosperous and satisfactory condition generally. He thought they might now look forward to a period of steadier prosperity, when nothing would interfere with a resumption of a normal condition of affairs, with the company's receipts also reaching the normal figure, although, he thought, they had nothing to complain of considering what had taken place. As to the working expenses, there was little to say. There was a considerable decrease in maintaining the buildings, not because the buildings had been neglected, but in consequence of the special expenditure which they had previously incurred. As to the maintenance of the cables, there was an inevitable outlay representing compensation paid to fishing vessels on account of damage. The company had short cables in comparatively shallow water between the end of the main cable and the American States. Fishing vessels were now accustomed to make use of heavier anchors and longer tackle, which sometimes inevitably fell foul of the company's telegraph cables. When that occurred rather than take the risk of having the cables pulled up and damaged in the effort to recover fouled ground tackle, the company found it prudent, after proper examination, to pay compensation for lost tackle of this kind. It was the most economical thing to do, for any repair, even in shallow water, was an expensive matter. The reserve fund had been debited with £5,097 for maintenance of cables. The practice was to make use of the interest earned upon the investments, in the first place, for this purpose. On the other hand, £5,000 was transferred to the reserve, which would now stand at £501,565. The investments, as was only natural, showed a small decrease, but on the whole, thanks to the care with which the securities had been selected, they had suffered very little. They would recollect that at the last meeting it was resolved to set aside a special reserve of £40,000 in order to meet any deficiency which might arise, and since then very little change had taken place in respect of the value of the investments.

SIR JAMES PENDER seconded the motion, and the report was adopted.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in, and to grant a quotation to—

Calcutta Tramways Co., Ltd.—Further issue of 12,128 5 per cent. cumulative preference shares of £5 each, fully paid.

The Committee has appointed Friday, January 31st, to be a special settling day in—

Canadian General Electric Co., Ltd.—Interim certificates, fully and partly (£16) paid, for $1,000,000 7 per cent. cumulative preference stock in shares of $100 each.

Central London Railway Co.—Dividends of 3 per cent. per annum on the ordinary stock and 4 per cent. per annum on the preferred stock, for the half-year ended December 31st; and 2 per cent. on the deferred stock, for the year 1907 have been declared. It is proposed to add £10,000 to reserve, and to carry £10,218 forward.

Germany.—Die Fabrik Isolirten Drahte zu Electrischen Zwecten (Vogel) Gesellschaft, of Berlin, is declaring a dividend of 6 per cent. for the last financial year.

City and South London Railway Co.—The directors recommend a dividend for the past half-year at the rate of 1¾ per cent. per annum on the ordinary stock, carrying forward £1,119. A year ago the distribution was at the rate of 2 per cent. per annum, and £2,521 was carried forward. At this time last year the dividend on all three classes of stock was at the rate of 4 per cent. per annum.

Liverpool Overhead Railway Co.—The accounts for the past half-year show an available balance of £9,105. The directors have resolved to recommend payment of a dividend at the rate of 5 per cent. per annum on the preference shares, and ½ per cent. per annum on the ordinary shares, and carry forward a balance of £4,179. Last year there was no dividend on the ordinary shares, and £4,246 was carried forward.

St. James' and Pall Mall Electric Light Co.—The directors recommend a dividend on the preference shares for the half-year ending December 31st, 1907, of 3s 6d. per share, and 5s. per share on the ordinary shares, making with the interim dividend paid on August 8th last, a total distribution of 7 per cent. on the preference, and 10 per cent. on the ordinary shares for the year. In the preceding year the dividend on the ordinary shares was at the same rate.

Rio de Janeiro Light and Power Co.—The Paris correspondent of the *Financial News* reports that the London branch of the Canadian Bank of Commerce is now negotiating a financial operation on behalf of the above company. It is thought that the negotiations are meeting with some difficulty.

Anglo-American Telegraph Co., Ltd.—The directors have resolved, after placing £20,000 to the credit of the renewal fund, to recommend balance dividends of £1 5s. per cent. upon the ordinary consolidated stock and £1 10s. per cent. upon the preferred stock for the year ending December 31st, 1907, and a first and final dividend of £1 per cent. upon the deferred stock for the year, all payable on February 8th next, less income-tax; £2,400 is to be carried forward. The above dividends, together with those already paid, will amount to £3 10s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and £1 per cent. on the deferred stock for the year 1907.

Central Electric Supply Co., Ltd.—A dividend of 5s. per share is proposed for the past year, carrying forward £43.

Prospectus.—*Bristol Tramways and Carriage Co., Ltd.*—This company has this week been offering for subscription at par an issue of £250,000 4½ per cent. mortgage debenture stock, which is required to meet outlays made, or to be made, upon authorised extensions, and for other developments of the business. The list was to close yesterday.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended December 27th, 1907, were 290,548, compared with 257,128 units in the corresponding four weeks of 1906.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Jan. 22	2,242	— 57	34	48,057	— 1,322	14·4	..
Ayr	,, 25	345	+ 27	37	11,461	— 68	8	..
Bath	,, 22	1,108	— 196	3	1,655	— 280	13	..
Belfast	,, 24	6,705	+ 528	43	157,290	+10,212	36	..
Birkenhead	,, 26	1,870	— 5	42	45,478	— 16	13·52	..
Birmingham Corp.	,, 18	12,358	..	3	16,010	+ 1,476	56·46	..
Blackburn	,, 22	1,853	+ 50	43⅔	48,021	+ 3,176	14·13	..
Blackpool Corp.	,, 23	592	— 24	..	48,930	— 1,251	11·87	..
,, —Fleetw'd.	,, 25	350	+ 2	3	688	+ 4	8·25	..
Bolton	,, 26	3,920	+ 164	43	97,591	+ 5,933	26	..
Bournemouth	,, 22	2,532	+ 49	42⅔	72,775	+ 1,642	21·5	..
Bradford	,, 18	8,250	+ 175	42	194,778	+ 4,478	54·9	1
Brighton	,, 26	1,296	— 16	43	39,055	— 3,189	9·5	..
Bristol	,, 24	9,176	+ 183	..	..	..	23·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 17	412	+ 12	2⅔	557	+ 46	3·65	..
Barnsley	,, 17	299	+ 10	,,	364	+ 22	..	..
Barrow	,, 17	404	+ 11	,,	485	+ 5	5·87	..
Cavehill	,, 17	106	+ 12	,,	126	+ 16	..	..
Devonport	,, 17	852	— 30	,,	1,042	— 46	8·85	..
Gateshead	,, 17	1,876	+ 60	,,	2,325	+ 119	11·25	..
Gravesend	,, 17	364	— 45	,,	434	— 51	6·5	..
Greenock	,, 17	828	— 199	,,	1,070	— 222	7·25	..
Hartlepool	,, 17	441	+ 3	,,	551	+ 14	6·72	..
Kidderminster	,, 17	157	— 12	,,	187	— 15	..	..
Leamington	,, 17	238	— 19	,,	290	— 27	8	..
Merthyr	,, 17	368	— 2	,,	439	+ 3	2·9	..
Metropolitan	,, 17	8,917	+1,250	,,	10,743	+ 1,488	22	..
Middleton	,, 17	552	— 9	,,	683	+ 25	3·5	..
Mid. Joint Com'tee	,, 17	4,809	— 213	,,	11,254	— 531	..	..
Oldham—Ashton	,, 17	1,064	— 23	,,	1,290	+ 7	9·13	..
Peterborough	,, 17	198	+ 9	,,	234	+ 10	5·31	..
Potteries	,, 17	3,581	+ 11	,,	4,246	— 10	22	..
Rothesay	,, 17	85	+ 3	,,	127	+ 10	2·75	..
Southport	,, 17	249	— 40	,,	436	— 15	3·17	..
S. Metropolitan	,, 17	1,267	— 131	,,	1,511	— 148	..	..
Swansea	,, 17	1,558	— 34	,,	1,868	— 12	5·5	..
Tynemouth	,, 17	280	— 9	,,	358	+ 5	3·75	..
Weston-s-Mare	,, 15	44	— 3	,,	48	— 2	8	..
‡Worcester	,, 17	445	— 20	,,	536	— 32	5·75	..
Wrexham	,, 17	162	— 14	,,	190	— 20	..	..
Yorks. Wool. Dist.	,, 17	1,632	— 143	,,	1,960	— 140	17	..
Miscellaneous	,, 17	181	+ 14	,,	428	+ 27	..	..
Burnley	,, 25	2,338	+ 112	..	..	..	7·5	..
Burton-on-Trent	,, 26	466	— 11	43	12,171	— 616	11	1·5
Bury	,, 19	1,966	+ 182	42	46,907	+ 5,720	10·5	..
†Cardiff	,, 11	1,894	— 24	41	88,894	+ 2,554	15·87	..
Carlisle	,, 25	284	+ 33	4	584	+ 13	..	..
Chatham and Dist.	,, 23	1,139	— 44	3	1,898	+ 240	12·21	..
Cork	,, 23	746	— 57	3	1,226	— 178	9·89	..
Croydon	,, 24	2,315	+ 24	43	60,518	+ 1,664	12	·75
Darlington	,, 25	365	+ 8	43	9,102	+ 40	..	..
Darwen	,, 24	447	— 13	43	10,930	— 58	4·36	..
†Dover	,, 18	155	— 21	42	9,531	— 1,194	4·75	..
Dublin	,, 24	9,338	+ 266	..	16,137	— 70	54·25	5·5
Dundee	,, 22	2,102	+ 114	36	41,625	+ 1,681	14·5	..
East Ham	,, 25	1,571	+ 51	43	39,011	+ 431	7·75	..
†Exeter	,, 6	240	— 12	36	11,507	+ 551	4·75	·5
Glasgow	,, 25	32,417	+ 471	33½	597,106	+16,486	39·25	5·5
Hastings	,, 24	1,417	..	..	..	..	..	..
Huddersfield	Dec. 28	3,110	+ 320	39	62,578	+ 2,989	28	..
Hull	Jan. 25	4,752	+ 295	43	106,424	+ 6,041	13	..
Ilkeston	,, 22	233	+ 9	43	6,090	+ 380	3·5	..
Ipswich	,, 25	572	— 86	43	17,192	— 1,109	10·5	..
†Isle of Thanet	,, 4	199	— 16	..	..	..	11	..
Kilmarnock	,, 25	273	— 12	36	5,777	— 149	4·25	..
Lan'kshire Trm Co.	,, 23	2,317	+ 543	3	4,361	+ 1,064	15·82	3·26
Lancashire United	,, 22	2,096	+ 75	3	3,447	+ 156	39	1
Leeds	,, 18	11,922	+ 238	42	274,710	+11,534	51·13	..
Leicester	,, 25	3,836	+ 123	..	..	..	..	..
Leith	,, 18	937	+ 10	35½	18,734	+ 136	6	..
Liverpool	,, 18	20,023	—1,282	3	26,247	— 1,719	104	..
‡L.C.C.	,, 11	57,871	+5,049	41	1,228,037	+210,635	116·5	10
London United	,, 25	9,674	— 30	..	17,407	— 1,453	..	..
†Lowestoft	,, 16	141	+ 2	18	2,694	+ 102	3·5	..
Manchester	,, 25	26,709	+ 705	43	533,747	+41,576	86	11
Newcastle	,, 25	7,532	+ 44	43	175,866	+ 1,248	..	..
†Newport	,, 18	561	+ 20	42	28,707	+ 2,054	14·5	..
Northampton	,, 24	723	+ 42	41⅔	18,514	— 309	5·5	..
Oldham	,, 26	3 312	+ 79	44	84,620	+ 5,672	23·75	..
Pontypridd	,, 25	575	+ 281	43	11,774	+ 4,587	5	1·75
Portsmouth	,, 25	2,847	+ 207	43	84,094	— 1,219	14·5	..
Preston	,, 22	1,305	+ 25	..	..	..	..	..
Reading	,, 23	1,030	— 16	42⅓	26,511	— 746	13·25	..
Rotherham	,, 23	1,107	+ 144	42⅔	25,974	+ 4,226	10	·66
Salford	,, 20	8,318	— 237	42	195,683	+ 5,781	38·9	..
Sheffield	,, 26	10,609	+ 475	44	245,278	+13,198	35·75	..
Southampton	,, 22	1,731	+ 167	42⅔	43,880	+ 2,542	..	..
Southend-on-Sea	,, 22	466	— 10	43	17,257	+ 74	..	..
Sunderland	,, 26	2,163	— 284	43	58,811	— 1,612	..	..
Swindon	,, 22	266	— 17	..	..	..	4·4	..
Tyneside	,, 22	695	— 22	4	1,116	— 53	8·87	..
Wallasey	,, 25	1,377	— 21	43	35,931	+ 625	8·72	·22
Walthamstow	,, 25	834	+ 110	43	25,880	+ 1,202	9	..
West Ham	,, 23	4,081	— 87	43	99,165	+ 2,023	14·7	..
Wolverhampton	,, 22	1,478	— 66	42	39,213	+ 421	13·5	..
†Yorks. W. Riding	,, 8	1 064	+ 87	49	56,924	..	..	..
Baker St.-Waterloo	,, 25	6,120	+1,404	4	12,630	+ 3,184	4·25	1
Cen. London Rly.	,, 25	12,491	— 892	4	25,008	— 787	5·77	..
Char. +, Eus. Hamp.	,, 25	6,880	..	4	12,690	..	7·75	..
City & S. Lon. Rly.	,, 26	6,297	+ 718	4	14,118	+ 1,620	7·8	1·05
Dublin-Lucan Rly.	,, 24	178	+ 6	4	302	— 18	7	..
G.N. and City Rly.	,, 25	3,787	— 111	4	7,479	— 281	3·5	..
G.N., P'dy. & Brmp.	,, 25	10,890	+3,626	4	21,665	+ 7,471	9·25	·25
L'pool Overh'd Rly.	,, 26	2,732	+ 48	4	5,403	— 182	6·8	4·8
Mersey Railway	,, 25	3 823	+ 184	4	7,789	+ 478	4·5	..
Metropolitan Rly.	,, 26	30,985	— 79	4	62,552	— 18	24·5	..
Met. District Rly.	,, 25	17,330	+1,337	4	35,474	+ 3,451	24	..
Anglo-Argentine	,, 21	35,098	+1 800	4	58,871	+ 2,692	48	..
§Auckland	Dec. 31	11,367	+1,554	52	137,719	+ 8,019	19·2	·56
§Brisbane	Dec.	15,390	—1,190	..	..	..	..	..
§Brit. Columbia Rly.	Nov.	37,275	+11,302	22	167,944	+48,363	6·8	4·8
Buenos A.& Belgr'o.	Jan. 21	7,105	— 135	3	11,282	+ 31	..	..
Calcutta	,, 25	6,388	—1,190	..	..	..	..	..
§Geneva	Nov.	7 583	+ 321	..	..	..	..	..
§Kalgoorlie, W.A.	Dec.	4,109	..	52	47,324	..	20·5	..
Madras	Jan. 15	1,312	+ 162	..	..	..	12·75	..
Perth (W.A.)	,, 24	2,995	— 179	4	5,264	— 505	25·6	·4

* Compared with the corresponding period of 1907. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

By the reduction in the Bank Rate to 4 per cent. last Thursday, the stock markets received a most welcome impetus to better prices, with the result that all the highest-grade securities have advanced materially in value. Consols rose in a manner almost skittish for so staid a stock, and the lead thus given to gilt-edged issues has been followed by every section where debenture stocks are in evidence. The better feeling took several days to find its way to the Home Railway Ordinary list, but early this week a recovery set in which has raised some of the quotations well above their just previously depressed levels.

One of the first consequences of this altered state of affairs is certain to be a scramble to get new issues out as quickly as possible. An interesting prospectus this week has been the issue at par of £250 000 4½ per cent. Debenture stock by the Bristol Tramways and Carriage Company, Ltd. There appears to be reasonable security for the stock.

Anglo-Argentine Tramways Debenture stock is 2 points up, Buenos Ayres and Belgrano Debentures are both decidedly better, the little scare about the friction between the Argentine Government and the Congress not troubling this part of the Argentine markets, though it caused temporary flatness elsewhere. Calcutta Debenture stock is 2 per cent. better, and so is Metropolitan Electric Tramways 4½ per cent. Debenture stock. The last named security at 95 looks nearly as good as the new Bristol Tramways stock at 100.

From these movements it will be noticed that the prior-charge stocks are much in request amongst investors. That the tramway department is not singular in this respect may be seen by a glance at the long catalogue of rises chronicled in the other lists overleaf. A study of the returns to be obtained from the purchase of debenture stocks and preference shares will show that there remains plenty of room for further improvement, and it cannot be expected that the demand for such investments is going to stop yet. Indeed, a further continuous rise seems to be exceedingly probable, more especially as there are plenty of indications that money will become cheaper still before the autumn.

The Central London dividends at the rate of 4 per cent. on the Preferred Ordinary, 3 per cent. on the Ordinary, and 2 per cent. for the year on the Deferred stocks, were much as the market expected, and the prices did not move upon the declaration. Metropolitan Consolidated is flat at 37, after being 41, the rise following upon the statement that the London and North-Western Railway meant to postpone the construction of their new electric line between Euston and Watford. Metropolitan District dropped to 10½. For the Great Northern and City to be unable to pay its Preferred Ordinary dividend of 4 per cent., will not come as a surprise to anyone who has watched the course of this so far unhappy undertaking. City and South London eased off to 44 upon the dividend being at the rate of 1¾ per cent., against 2 per cent. last year, while the carry-forward also is smaller.

Electricity supply shares are steady at their improved prices, but there are not many new advances to record. City of London Preference and London Electric Supply Preference have gained 5s. apiece, and Metropolitan Ordinary shares at 6¼ are again better. One or two Debenture stocks have risen a little. The market is going "easy," rather anxious to see whether the next batch of dividends will be up to the standard of last year. The first to be declared, that of the St. James's and Pall Mall, is the very satisfactory distribution of 5s. per share, making 10 per cent. for the year.

Electric Construction shares are good, the Ordinary adding 1/8 and the Preference ¼. Dick, Kerr shares are rather easier. Brush 6 per cent. Preference fell to 5s. Cromptons have risen to 1¾. British Electric Traction shares are also weak, all classes falling upon the official announcement that the question whether the Preference dividend this time shall be paid or not, is to be left for the proprietors to settle at the next meeting.

In the Telegraph market a mild sensation has been caused by the declaration of a dividend of £1 per cent. upon Anglo-American Telegraph Deferred stock. This brought about a bear-squeeze which lifted the price 1½. The 6 per cent. Preferred, however, is only ½ better, and the Ordinary failed to score at all. Cuba Telegraphs are a good market, and Great Northerns pursue their advance. West India and Panama shares are decidedly better, but West Coast of America shares lost 5/16 of their sharp twist up, returning to 1⅞.

A good business is being done in Globe Telegraphs, and the Preference have put on ¼. Mackay Common rose 2, while the Preferred eased off. Commercial Cable Debenture stock has hardened.

Anticipations of a 6 per cent. dividend on the stock caused a rise of 3½ in National Telephone Deferred, while the company's other issues are mostly better. American Telephone Common stocks slipped back a point, and other telephone varieties are firm.

Marconi shares failed to derive any benefit from the announcement that the sixpenny rate would be inaugurated in Montreal within a few days. The price at 12s. 6d. is unmoved.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations Jan. 21st.	Closing Quotations Jan. 28th.	Business done week ended Jan. 28th, 1908. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2 — 3	2 — 3	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	..	84 — 87	84 — 87	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7½%	7½%	8 %	..	111 —114	110 —113	..	..	—1	7 1 7
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	..	86 — 88	86 — 88	..	..	..	4 10 11
660,660	Anglo-American Telegraph	Stock	2½%	3½%	3½%	3½%	56 — 59	57 — 60	57½	..	+1	5 16 8
3,169,670	Do. do. do. 6 % Pref.	Stock	5½%	6 %	6 %	6 %	100½—102½	101 —103	103½	101	+ ½	5 16 6
3,169,670	Do. do. do. Deferred	Stock	Nil	½%	12½%	1 %	15 — 15½	16½— 17	17 7/16	15	+1½	5 17 8
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	..	99 —102	99 —102	100½	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	6½— 7½	6½— 7½	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	80 — 84	82 — 85	88½	83	+1½	4 14 2
16,000	Cuba Telegraph	10	5 %	5 %	5 %	..	6½— 7½	6½— 7½	..	..	+ ½	6 13 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	15½— 16½	15½— 16½	..	..	+ ½	5 19 5
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	8½— 9	8½— 9	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	..	8½— 8¾	8½— 9	..	..	+ ⅛	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	..	97 —100	98 —101	..	..	+1	3 18 2
60,710	Direct United States Cable	20	3½%	4½%	4½%	..	13½— 14½	13½— 14½	13 5/16	..	..	6 10 9
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	131 —136	130 —135	133	130	—1	5 3 8
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	82 — 86	82 — 85	83½	82	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	102	100	..	3 18 5
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	12¾— 13¼	12¾— 13¼	12¾	12¾	..	5 7 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	100 —103	101 —104	..	..	+1	3 16 11
295,400	Eastern Extension, Australasia, and China Tele.	100	4 %	4 %	4 %	..	98 —101	99 —102	..	..	+1	3 18 5
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99 —101	99 —101	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5%	5%	5%	..	9¼— 10⅜	9¼— 10⅜	10¼	10	..	4 16 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13 — 13½	13⅛— 13⅜	13 7/16	13⅛	+ ⅛	4 7 9
150,000	Great Northern Telegraph, of Copenhagen	20	24 %	24%	20 %	..	30 — 32	30 — 32	31⅛	30½	..	6 5 0
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	52 — 55	52 — 55	52½	52⅛	..	6 5 0
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3½%	..	60 — 65	58 — 64	63	..	—2	5 11 1
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	..	63 — 68	61 — 67	..	..	—1½	5 19 5
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1/16— 1/32	1/16— 1/32	..	..	..	Nil
72,689	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	..	1/16— 1/16	1/32— 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	..	1/16— 1/16	1/32— 1/16	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	..	110½—112½	111 —113	112	110½	+ ½	5 6 2
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	..	107½—109½	110 —112	111	108	+3½	4 9 3
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	..	11 — 13	11 — 13	13	11½	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	..	10 — 12	10½— 12½	..	..	+ ½	4 0 0
250,000	Do. do. do. 5 % Non-cum. 3rd P., 1 to 250,000	10	6 %	6 %	5 %	..	5½— 6½	5 5/16— 5 15/16	5½	..	— 1/16	4 9 11
2,000,000	Do. do. 3½ % Deb. Stock Red.	5	5 %	5 %	5 %	..	96½— 98½	97 — 99	97½	..	..	3 11 1
1,689,598	Do. do. 4 % Deb. Stock Red.	Stock	3½%	3½%	3½%	..	99 —101	99 —101	100⅜	100	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	100	4 %	4 %	4 %	..	1½— 1⅝	1½— 1⅝	23/1½	..	..	5 17 11
50,000	Do. do. do. 6 % Cum. Pref.	1	6½%	7 %	7 %	..	1⅛— 1⅛	1⅛— 1⅛	..	..	..	5 1 1
100,000	Do. do. do. 4 % Red. Deb. Stock	1	6 %	6 %	6 %	..	1⅛— 1⅛	1⅛— 1⅛	..	..	..	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	4 %	4 %	..	90 — 93	90 — 93	..	..	+1	3 19 3
11,889	Reuter's	10	4 %	4 %	4 %	..	97 —100	98 —101	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	8	5 %	5 %	5 %	..	7 — 8	7 — 8	..	..	..	4 8 3
3,167	Submarine Cables Trust	100	..	4½%	4½%	..	99 —102	99 —102	..	..	+1	4 18 9
80,000	United River Plate Telephone	Cert.	6 %	6 %	6 %	..	124 —127	125 —128	..	..	..	5 14 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	8 %	8 %	8 %	..	6⅜— 7	6⅜— 7	6⅛	..	..	4 15 3
15,609	West African Telegraph, Shares	5	5 %	5 %	5 %	..	4½— 5½	4½— 5½	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	10	4½%	4 %	4 %	..	10 — 10½	10 — 10½	..	..	..	11 8 6
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	2	Nil	Nil	2½%	..	1⅛— 2⅛	1⅛— 1½	35/-	..	— 1/16	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	100	4 %	4 %	4 %	..	97 —100	98 —101	..	..	+1	5 4 8
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	97½—100½	97½— 98½	13½	..	..	3 19 3
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1/32— 3/32	1/32— 3/32	100⅛	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	..	7⅛— 8	7⅛— 8	9/4½	8/1½	+ ⅛	10 0 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	7½— 7¾	7½— 8	..	..	+ ⅛	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	..	99 —102	100 —103	7 7/8	7⅞	+ ⅛	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 530,097	5	8 %	8 %	8 %	..	7½— 8½	7½— 8½	8 1/16	7⅜	..	4 17 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5½%	5½%	5½%	..	5⅞— 6⅛	5⅞— 6⅛	6 1/32	5⅛	+1½	4 9 10
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	..	125 —128	126 —131	128	..	..	4 11 7
265,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	..	102 —105	102 —105	..	..	..	4 15 3
330,000	Babcock & Wilcox, 1 to 330,000	1	20 %	20 %	20 %	..	3½— 3¾	3½— 3¾	73/9	71/10½	..	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	..	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..	3 16 10
400,000	British Aluminium, Ord., 2,001 to 40,000	5	7 %	7 %	7 %	..	3⅜— 4¼	4⅛— 4⅜	74/-	..	..	7 15 7
38,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	4⅜— 5⅛	4⅜— 5⅛	98/1½	..	..	6 16 7
40,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	..	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 11 8
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	..	3¾— 4¼	3¾— 4¼	..	..	..	4 14 1
20,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	100 —103	100 —103	..	..	+1	5 13 5
258,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	5½%	..	97 —100	98 —101	..	..	..	5 8 11
800,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	..	125 —128	125 —128	..	..	..	4 13 9
400,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	105 —109	105 —109	..	..	..	4 11 9
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	99 —103	100 —104	..	..	+1	4 16 2
800,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	100	4½%	4½%	4½%	..	100 —103	100 —103	..	..	..	4 7 3
298,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	40	4½%	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 3
220,000	British Electric Traction	100	4½%	4½%	4½%	..	1⅜— 1⅝	1⅛— 1⅜	31/8	27/6	— ⅛	Nil
133,301	Do. do. 6 % Cum. Pref.	10	6 %	3 %	Nil	..	4⅝— 4⅞	4⅛— 4⅜	5 1/16	90/-	— ⅛	12 12 8
161,437	Do. do. 5 % Perp. Deb. Stock	10	6 %	6 %	6 %	..	4⅝— 5⅛	4⅝— 4⅞	95	91½	—1	5 11 1
1,448,658	Do. do. 4½ % 2nd Deb. Stock Red.	Stock	5 %	5 %	5 %	..	92 — 95	90 — 95	95	91½	—1	6 3 3
410,178	British Insulated and Helsby Cables	100	4½%	4½%	4½%	..	69 — 74	68 — 73	70½	69	—1	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	8 %	8 %	10 %	..	6½— 7	6½— 7	..	..	..	4 18 0
100,000	Do. do. 4½ % 1st Mort. Deb. Red.	5	6 %	6 %	6 %	..	5⅝— 6⅛	5⅝— 6⅛	5½	..	..	4 7 5
500,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	..	100 —103	100 —103	..	..	..	4 18 11
212,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	100	4½%	4½%	4½%	..	86 — 89	85 — 89	..	..	..	Nil
400,000	Do. do. 4 % Mort. Deb. Stock	5	Nil	Nil	Nil	..	⅞— 1	⅞— 1	..	..	..	8 17 10
1,016,858	Browett, Lindley & Co., Ord.	100	4 %	4 %	4 %	..	40 — 45	40 — 50	42	..	..	Nil
50,000	Do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	1/16— 1/32	1/16— 1/32	..	..	..	Nil
50,000	Brush Electrical Engineering, Ord., 1 to 105,731	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Do. do. Non-cum. 6 % Pref.	£1	Nil	Nil	Nil	..	0 — ½	0— ½	..	..	..	Nil
150,000	Do. do. 4½ % Perp. Deb. Stock	2	2½	2¾%	Nil	..	½— ¾	½— ⅞	3/1½	..	— ½	Nil
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock	2	6 %	6 %	Nil	..	½— ¾	½— ¾	..	..	..	5 4 8
125,000	Buenos Ayres & Belgrano, 1 to 100,000	Stock	4½%	4½%	4½%	..	83 — 86	83 — 86	..	..	..	6 16 4
100,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	Stock	4½%	4½%	4½%	..	63 — 66	63 — 66	..	..	..	3 1 6
40,000	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	..	4½— 5⅛	4⅝— 4⅞	93/9	92/6	+3/9	5 14 3
27,500	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	..	4½— 5⅛	4⅝— 5⅛	5	..	..	5 14 3
13,200	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	..	4½— 5⅛	4⅝— 5⅛	..	..	..	5 14 3
190,000	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	..	105 —115	110 —116	..	..	+1	4 6 2
137,610	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	5 %	5 %	..	101 —104	102 —105	..	..	+1	4 15 3
30,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	..	6⅜— 6⅝	6½ — 7	..	..	+ ⅛	5 14 3
350,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	..	4½— 4⅝	4⅝— 4⅞	5 1/16	..	+2	4 13 0
35,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	99 —103	101 —105	101	..	..	4 5 9
40,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	9½— 10⅛	9⅝— 10⅜	10⅛	10	..	7 6 4
300,000	Cape E Trams., 1 to 491,222	1	5 %	Nil	Nil	..	5⅛— 5⅜	5¼— 5⅝	5⅝	5 1/16	..	4 6 11
491,222	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	..	1½— 1⅝	1½— 1⅝	..	..	..	4 4 11
450,000	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	101 —104	101 —104	..	..	..	Nil
224,988	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	65 — 68	65 — 68	68	66½	..	5 16 4
911,568	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	84 — 86	..	..	..	4 6 7
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	43 — 46	44 — 47	44½	..	..	4 8 3
544,216	City and South London Railway	Stock	4 %	4 %	4 %	2 %	44 — 46	44 — 46	45	44	..	4 13 0
1,480,000		Stock	2½%	1½%	2½%	2½%						4 5 1
												4 12 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Jan. 21st.	Closing Quotations Jan. 28th.	Business done week ended Jan. 28th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	5 %	..	1 11/16 — 1 15/16	1 13/16 — 2	..	..	+ 1/16	7 10 11
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	94 — 97	93 — 96	..	..	—1	5 4 2
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	..	1 1/8 — 1 3/8	1 — 1 1/4	..	..	— 1/8	8 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1 1/4	1 — 1 1/4	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	..	13 — 14	13 — 14	..	..	..	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	12 3/8 — 13 3/8	12 3/8 — 13 3/8	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	4½%	4½%	..	1/16 — 1/8	1/8 — 1/4	..	..	..	11 7 6
17,139	Do. "A" shares, 01—017,139	5	2½%	4½%	4½%	..	1 1/8 — 2 1/8	1 1/8 — 2 1/8	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	78 — 81	78 — 81	..	..	..	4 18 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	+ 1/16	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	Nil	..	1 1/8 — 1 1/4	1 1/8 — 1 1/4	29/-	..	+ 1/2	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7 1/2 — 8 1/4	7 1/2 — 8 1/4	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	..	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	..	1 1/4 — 1 3/8	1 1/4 — 1 3/8	..	..	..	17 15 6
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10 1/4 — 10 3/4	10 1/4 — 10 3/4	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	..	10 1/2 — 11 1/2	10 1/2 — 11 1/2	11 1/16	10 15/16	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	4 1/4 — 5 1/8	4 1/4 — 5 1/8	..	..	..	8 19 1
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	104½—106½	104½—106½	106	104½	..	4 4 6
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	5 %	10%	10 %	..	14 1/4 — 15 1/2	14 1/2 — 15 1/2	15	..	..	6 9 0
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	Nil	Nil	..	1 3/8 — 1 1/2	1 3/8 — 1 1/2	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	..	8 — 8 1/2	8 — 8 1/2	..	..	..	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	3 %	3 %	..	6 1/2 — 6 3/4	6 1/2 — 6 3/4	..	..	..	4 8 11
899,930	Do. do. 60,008 to 100,000	10	6 %	3 %	3 %	..	6 1/2 — 6 3/4	6 1/2 — 6 3/4	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	..	7 1/2 — 8 1/2	7 1/2 — 8 1/2	..	..	..	5 17 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	80 — 84	81 — 85	81 7/8	81 1/4	+1	4 14 2
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	1/3	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1/16 — 1/8	1/16 — 1/8	17/6	16/9	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	..	91 — 94	93 — 96	93½	..	+2	4 13 9
245,500	Potteries E. Trc.	1	5 %	4 %	4 %	..	1/16 — 1/8	1/16 — 1/8	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1/2 — 5/8	1/2 — 5/8	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	93 — 96	93 — 96	..	..	..	4 18 9
87,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	..	28½ — 30½	29 — 31	29⅞	..	+½	5 5 6
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	..	99 —102	100 —103	..	..	—1	3 17 8
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	..	36 — 40	36 — 40	..	..	..	12 10 0
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	£1	Nil	Nil	Nil	5 %§	1 — 1½	1 — 1½	..	..	..	
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	..	3½ — 3⅝	3½ — 3⅝	65/7½	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	72 — 77	72 — 77	73½	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5½%	5½%	5½%	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	..	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	..	7 — 8	7 — 8	..	..	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7 — 8	7 — 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	..	97 — 100	97 —100	..	..	..	4 0 0
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	..	4⅛ — 5	4⅛ — 5	98/9	92/6	..	5 0 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4⅛ — 5	4⅛ — 5	98/9	..	..	4 10 0
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4¼ — 4⅜	4¼ — 4⅜	..	..	..	4 14 9
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..	4 0 0
49,436	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	..	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	5 5 11
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	..	100 —103	101 —104	..	..	+1	4 6 7
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	..	10 — 11	10 — 11	10⅜	10 1/16	..	5 9 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	11½ — 12½	11½ — 12½	12⅝	..	+ ⅛	4 16 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	..	120 —123	120 —123	122½	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	..	97 —100	97 —100	..	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	..	3½ — 4¼	3⅝ — 4¼	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	..	6½ — 7⅛	6½ — 7⅛	..	..	..	6 13 4
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10⅝ — 11⅛	10⅝ — 11⅛	11	10 1/16	+ ⅛	5 6 8
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	..	103 —106	103 —106	..	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	..	95 — 98	95 — 98	..	..	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	..	3/8 — 7/16	3/8 — 7/16	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	..	1/2 — 1	1/2 — 1	..	..	..	10 0 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	70 — 80	70 — 80	..	..	..	5 12 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	4½ — 5	4½ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	..	5 — 5½	5 — 5½	..	..	..	4 10 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	..	94 — 97	94 — 97	..	..	..	4 12 9
12,000	Hove, 1 to 12,000	5	8½%	9 %	9 %	..	6⅜ — 6⅝	6⅛ — 6⅜	..	..	— ⅛	6 13 4
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	..	8 — 9	8 — 9	..	..	..	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	96 — 99	96 — 99	..	..	..	4 0 10
111,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	..	1½ — 1⅝	1½ — 1⅝	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅜ — 4⅝	4⅜ — 5⅛	97/6	92/6	..	6 3 1
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4%	..	90 — 94	90 — 94	92	..	..	4 15 9
300,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	..	5⅞ — 6⅜	6 — 6½	6⅛	6 1/16	+ ⅛	6 3 3
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	..	4⅜ — 5⅛	4⅞ — 5⅛	5	..	..	4 3 9
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	..	101 —105	102 —106	..	..	+1	4 4 11
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	..	85 — 90	85 — 90	..	..	..	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	95 — 98	96 — 99	..	..	+1	4 10 11
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	..	6½ — 6⅝	6½ — 6⅝	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	..	11½ — 12½	11½ — 12½	..	..	..	6 2 5
90,000	Oxford, 1 to 96 and 407 to 20,810	5	7 %	7 %	7 %	..	5⅝ — 6	5⅝ — 6	5⅞	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	..	93 — 95 xd	93 — 95	..	..	..	4 4 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7⅞ — 8⅜	7⅞ — 8⅜	8⅛	..	..	5 14 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6½ — 7⅛	..	..	..	4 13 4
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	..	⅜ — 1½	⅜ — 1½	..	..	..	Nil
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	71 — 75	71 — 75	..	..	..	5 4 4
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	..	2½ — 3	2½ — 3	..	..	..	5 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	..	⅜ — ½	⅜ — ½	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	3 14 8
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	101 —104	101 —104	..	..	..	4 6 7
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	1½ — 2½	1½ — 2½	..	..	..	12 10 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2½	2 — 2½	..	..	..	10 0 0
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	..	90 — 93	90 — 93	..	..	..	4 16 9
110,000	Westminster Electric Supply, Ord.	5	14 %	13 %	12 %	..	8½ — 9⅛	8½ — 9½	9 1/16	8½	..	6 6 4
61,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	..	5 — 5⅛	5 — 5⅛	5¼	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 4 per cent. January 23rd, 1908.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING DECEMBER, 1907.

The returns of the last month of the old year show a considerable fall in values in all three sections. The exports which amounted to £154,631, compare with £184,634 in November; the imports totalling £146,127, as against £158,884, and the re-exports £12,970, as compared with £21,776 in the preceding month. Though these totals represent considerable reductions on the high figures ruling during recent months, and are below the respective averages for the year 1907, yet they are in excess of the averages of 1906.

As is usual, both in the exports and imports, electrical machinery and cables figure as the most prominent items, but the amount of electrically-driven plant dealt with was very small, and no tramway material figures in the table.

India again takes precedence as a purchaser, followed by the Argentine, New South Wales and Japan; and of the importing countries, Holland, with a total of nearly £50,000, is easily first, as was the case in the preceding month.

Telephonic imports totalled some £15,943 (towards which Belgium contributed some £9,000 worth), and are slightly higher in value than in November.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	533	1,718	38	10	201	2,604	...	...	52	31	...	4,187
Germany	231	670	77	22	...	3,537	6	33	34	...	...	4,610
Netherlands	88	266	293	23	...	284	...	...	...	4	...	958
Belgium	59	454	111	82	214	554	...	31	600	...	...	2,105
France and French Indo-China	379	187	331	12	8	578	...	5	...	...	...	1,500
Portugal, Madeira, Portuguese Africa & India	330	10	575	...	28	67	...	...	108	...	...	1,118
Spain	54	...	329	17	...	2,959	...	6	...	...	...	3,365
Italy, Austria-Hungary and Greece	244	157	19	...	179	841	...	...	84	...	...	1,524
Roumania and Turkey	106	...	...	...	...	...	...	...	...	...	...	106
Channel Isles, Gibraltar and Malta	125	...	95	25	...	187	...	...	...	...	...	432
U.S.A., Phillipines and Cuba	314	...	10	23	34	435	22	...	...	...	...	838
Canada and Newfoundland	205	593	121	12	122	320	...	...	5	...	...	1,378
British West Indies, British Guiana and Falkland Islands	49	....	46	22	142	193	...	...	7	...	...	459
Mexico, Colombia, Venezuela and Panama ...	298	58	60	12	...	2,332	...	...	25	...	...	2,785
Chile	62	62	...	330	107	2,022	60	...	...	...	...	2,643
Brazil	504	2,512	172	24	160	2,687	...	...	23	...	...	6,082
Argentine	3,733	3,281	269	430	807	9,212	8	105	826	...	...	18,671
Egypt	194	2,154	32	121	228	2,539	...	...	273	...	...	5,541
British West Africa and St. Helena	37	83	84	...	...	24	18	...	159	...	...	405
Cape of Good Hope	639	3 178	143	92	299	533	14	42	22	...	...	4,962
Natal	453	928	256	142	732	566	69	54	276	...	...	3,476
Zanzibar, Brit. East Africa, Mauritius & Aden	6	73	160	10	...	...	...	...	101	...	...	350
China and Siam	1,436	935	162	38	334	3,749	120	...	73	...	...	6,847
Japan	384	6,390	2,385	77	493	5,261	12	...	312	214	...	15,528
Java	...	...	...	...	...	302	...	...	...	...	...	302
India...	1,117	2,860	1,326	903	513	12,837	260	183	267	1,563	...	21,829
Burmah	223	2,887	72	141	...	138	5	...	15	37	...	3,518
Ceylon	87	45	141	14	88	4	11	...	...	51	...	441
Straits Settlements and Fed. Malay States ...	302	106	249	248	134	1,120	159	60	159	32	...	2,569
Hong Kong	86	180	92	3	...	906	6	4	9	...	...	1,286
West Australia	121	1,090	...	14	8	25	77	...	300	...	...	1,635
South Australia	819	251	5	...	25	3,022	...	...	259	...	...	4,381
Victoria	944	9 613	145	726	42	411	14	21	43	...	...	11,959
New South Wales	1,442	3,602	...	119	...	2,064	340	...	..	662	...	8,229
Queensland	...	268	74	83	...	188	...	18	...	...	...	631
Tasmania	...	2,052	..	...	7	...	...	...	35	...	...	2,094
New Zealand	267	1,281	1,052	128	70	1,627	213	3	146	...	...	4,887
Total, £	15,871	47,044	8,924	3,903	4,975	65,128	1,414	565	4,213	2,594	...	154,631

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	...	600	12	48	...	1,145	186	...	3,642	...	...	5,633
Germany	309	5,684	2,920	11,699	10	26,739	430	1,544	1,476	...	...	50,811
Holland	426	9,865	1,812	9,571	374	1,907	265	8,358	1,290	...	...	33,868
Belgium	875	5,184	352	8,301	68	4,302	204	1,797	9,035	...	...	30,118
France	470	2,500	2,236	1,441	1,219	359	539	3,560	125	...	...	12,449
Italy	...	156	...	....	45	...	....	...	...	...	...	201
United States	2,671	190	1,208	155	...	7,024	4	291	375	1,129	..	13,047
Total, £	4,751	24.179	8,540	31.215	1,716	41,476	1.628	15,550	15,943	1 129	...	146,127

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	3,506	2,769	284	1,597	352	1,055	22	237	3,016	132	...	...

Total Exports: £154,631 Total Re-Exports: £12,970 Total Imports: £146,127

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

GAS-TIGHT SWITCHES.

By W. BOLTON SHAW, M.Sc., A.M.I.E.E.

In the leading article of a recent issue of this journal on "Electrical Accidents in Mines," an accident which occurred in North Staffordshire is described, in which one man was killed and another injured by an electrically fired gas explosion. The immediate cause of the explosion appears to have been an accumulation of gas in the box containing the main switch of a 100-H.P. shunt-wound motor. The field circuit of the motor was opened by this switch, the starting being effected by a controller in the armature circuit. A shunt resistance, provided as a discharge path for the field, was found to be inoperative, and on opening the main switch the large inductive arc resulting from this defect evidently fired the gas in the switch-box. An explosion resulted which blew out the glass window of the box, and extended to a further accumulation of gas in the motor-house. The view is expressed in the article that had the shunt resistance not been inoperative, the accident would not have happened.

To the writer this does not appear to quite follow from the facts of the case, as set forth in the article and briefly recounted above, because even if the shunt resistance had been in operation at the time, there would still have been a spark at the switch contacts when the field was switched off the mains. This spark, due to the breaking of a current of several amperes at 500 volts, would, in his opinion, be sufficiently intense to fire an explosive mixture. It would appear that the accident could only have been prevented (apart from the question of ventilation) by the switch-box being really gas-tight, a condition somewhat difficult to obtain in many of the so-called gas-tight switches at present on the market, and impossible in some.

This problem of the gas-tight switch is of the greatest importance in mining work, and in view of the extensive use of electricity in mines, it is one to which manufacturers might profitably pay more attention. The writer has made a study of the subject from the user's point of view, and in this article he proposes to set forth some of the main principles on which the design of this class of switch should be based.

Probably the condition of absolute "gas-tightness" is only obtained in the oil-immersed type of switch, and experience has proved this to be eminently satisfactory for three-phase work underground. The oil switch has the additional advantage that the gas-tight condition can be maintained practically for an indefinite period, as it merely requires the existence of a head of oil above the switch contacts. The leading-in of the wires or cables is a comparatively simple matter, as glands are not necessary, an examination of the switch can easily be made, and, provided care is taken not to spill the oil, the "gas-tightness" of the switch will not in any way be interfered with by the examination.

The mere fact of its being oil-immersed is not, however, sufficient in itself to recommend a switch. The head of oil above the sparking contacts should be amply sufficient to prevent any danger of an arc reaching the surface in the event of the switch being opened on a current of several times the normal rating. Varnishing of the tank or other provision should be made to prevent loss of oil by creeping, and the tank should be as completely enclosed as possible to keep out dust and also prevent evaporation. No screws or bolts should pass through the sides of the tank below the oil level, and the same applies to the leads even when glands are used. If rubber-insulated leads are carried down into the oil, care should be taken in the design that there is no possibility of their coming into contact with the metallic sides of the tank, as rubber insulation soon deteriorates in oil.

For underground lighting work, both alternating and direct-current, small oil switches and fuses are satisfactory in use and simple in construction. The ordinary 5 or 10-ampere turn switch fitted with a long thumb piece (of hard wood), and fixed, along with a similar cut-out, in a small oil tank of suitable design, makes a reliable and inexpensive gas-tight lighting switch, which can also be used for small direct-current motors. Where it is necessary to have a double-pole switch a pair can be used.

For direct-current work, where an air-break switch may be preferable, the problem resolves itself into making the box containing the switch gas-tight, and the arrangements should be such that the switch-box is not only gas-tight when it leaves the manufacturer, but that after being installed it may be opened out frequently for inspection and repair if need be without its "gas-tightness" deteriorating. Joints made with rubber, cord or other perishable or destructible material are unsatisfactory, and the writer has found a circular tapered metal to metal joint, accurately turned, to be the best solution of this part of the problem. The lid should be held on by such a number of bolts, that in the event of one being lost or broken it is impossible to refix the lid with the remainder. This will prevent the joint from being improperly made and escaping observation. It is often a good plan where a possible defect cannot be entirely guarded against, to so arrange the design that if there is any defect at all, it will be sufficiently glaring to command immediate attention. Where the lid has marks on it indicating the "off" and "on" positions of the switch, it should not be possible to fix the lid in any but the position corresponding to the marks, and this can be ensured by unequal spacing of the bolts.

All cables entering the box, as well as the rod or pin for operating the switch, should do so through glands so designed that they can be made gas-tight and remain so. If the cable is armoured, the armouring should not be taken through the gland, and in the case of a two or three-core cable, a separate gland should be provided for each core. A type of gland somewhat similar to that of the piston-rod of a steam engine, which can be properly packed, is by far the most satisfactory. For packing, any handy material may be used, such as "pitch-band" or spun-yarn greased with tallow (dry spun-yarn is porous, and therefore not gas-tight). Rubber rings are not altogether satisfactory.

The gland itself should consist of a metal bush threaded on the outside and provided with a hexagonal flange, the stuffing box being tapped out with a corresponding thread. The hole through the stuffing box and gland must be lined with insulating bushes of fibre or other suitable material, and these should have a flange on their inner ends to prevent their being forced outwards when the gland is tightened on to the packing. The faces of these flanges should be mitred in the ordinary way.

Screws and bolts should not pass through the metal of the casing. Where attachments are made, the casing should be provided with bosses or ribs sufficiently thick for a blind hole to be drilled and tapped in them. Where it is impossible to avoid a through hole, this should be arranged to be threaded and the bolt screwed into it, the joint between the two threads being of much better quality than that between a through bolt and the sides of a plain hole.

In the preceding remarks, oil-break and air-break switches have each received separate treatment, but there are a number of points common to both to which attention should be paid.

The conditions existing underground should be kept well in view in designing the switch, and ignorance of these probably accounts for the unsuitability for mining work of a number of types which are satisfactory enough on the surface.

The workmanship should be of good quality, and the external parts and case should be strong enough to stand the sort of usage to be expected from heavy handed men, and to resist fracture by falls of rock from the sides or roof of the mine. At the same time, in the writer's opinion, the excessive weight and clumsiness of some of the designs on the market are quite unnecessary and are much more of a fault than a virtue. A switch can and ought always to be fixed in a selected place where it will be properly protected from accidental injury, and under the new Electricity Rules the ordinary discipline of the mine should be sufficient protection from abuse and improper handling by unauthorised persons.

Switches are used in many places underground where it is quite impossible to solder, and for this reason mechanical terminals should always be provided. Glands which require to be filled with compound are unsatisfactory and are quite useless except in places near to the pit, to which hot compound can be carried without becoming too cold to pour.

Small loose screws should be avoided for fixing doors and other parts which have to be removed for fixing, connecting up and inspecting the switch. The floor of a mine is usually covered with loose rubbish or dirt, amongst which a dropped screw is in much the same predicament as a needle in a haystack, with the difference that the haystack is usually in the daylight. Studs should not be used, as when broken it is practically impossible to replace them on site. For fixing the lid, hinged bolts and wing nuts form much the most convenient and satisfactory arrangement.

The "off" and "on" positions, with arrows showing the movement, should be marked on the switch, so that if necessary it is possible for a person quite unacquainted with the switch to use it without hesitation. An earthing terminal should be cast on the casing, and the handle of the switch should always be made of, or properly cased with, insulating material, so that whatever electrical defect there may be in the switch the handle can be grasped without fear of shock.

Wherever insulated cables, or wires not protected by armouring, pass through the metal casing, whether glands are employed or not, the holes must be lined with bushes of hard insulating material, and these ought to be fixed in such a way that there is no possibility of their working out of position. The switch casing should be designed so that it can easily be opened up for inspection, and it should be possible to do this without danger of the lid or tank coming into contact with any live part while being removed.

With regard to the switchgear itself, the writer does not propose to make any remarks, as there are no doubt many excellent types on the market, the result of long years of experience and practice.

Most of what has been said applies with equal force to gas-tight fuses.

In coal-cutter and certain classes of other motor work, fuses have to be frequently renewed, and it is therefore especially necessary that the uncovering and covering of the fuses should be repeatedly carried out without any possibility of the "gas-tightness" deteriorating, particularly as the renewal has often to be done by a man with little mechanical skill.

For this class of work, the air-break fuse is much more convenient than the oil-break, and provided care is taken in designing the joint and glands of the former, the writer is of opinion that its "gas-tightness" can be better relied on than that of the oil-break fuse in the hands of an unskilled man.

Where switches and fuses are to be used with armoured cable, some means should be provided for anchoring the armouring to the case. The arrangement should form an integral part of the case or be possible of attachment to it or to the board on which the switch and fuse are mounted.

The design of controllers and starting resistances, as regards gas-tightness, should be governed by much the same principles as switches. Where the resistance is oil-immersed, allowance should be made for the expansion of the oil when hot. This may be sufficient to raise the surface of the oil in a deep tank as much as 2 or 3 inches, and any openings through the walls should be placed higher by this amount than the surface of the oil when cold, the height of the latter being determined by the necessary head above the sparking contacts.

THE USE OF HEATER-DETARTARISERS.

By A CENTRAL STATION MAN.

In many central stations throughout the country, particularly those of the smaller type where condensing is only partially carried on, feed heaters are found to be of excellent value in utilising the waste heat of exhaust steam by the process of imparting it to the cold feed-water supply on its passage to the feed pumps. Where the water is charged with temporary hardness, these heaters exercise the further function of removing from the supply the scale-forming ingredients, and one of the best known examples of this class of apparatus is the Boby heater, which consists of a number of shallow circular cast-iron trays placed one on the top of the other, so as to afford a series of reservoirs or pools for the passing water. Each tray has a hole in the base, furnished with a projecting rim standing up about 3 in. from the bottom of the tray. The water enters the top tray, and fills this until it overflows into the next tray, and so on; at the same time the steam from the exhaust enters at the bottom of the series of trays and finds its way upwards through the range by way of the same holes through which the water is trickling down. The necessary impulse to overcome the slight internal friction opposed to the passage of steam by the apparatus is afforded by the condensing effect produced by the water on the steam, resulting in a small vacuum within the apparatus. In this way the infliction of back pressure on the engine is avoided.

Heater-detartarisers, of which the Boby heater has been mentioned as an outstanding type, are very efficient in a small plant running non-condensing, where all the exhaust from the main engines can be passed through the heater; in this case temperatures can, under ordinary conditions, be easily obtained of 120° to 150° F. on the discharge, or pump suction, with a temperature at the intake of 60°. These are not particularly good temperatures for feed water, but if there is no economiser or other means of heating the feed, the use of this apparatus is at once apparent.

This class of apparatus, however, although simple, has certain points which need to be observed in course of use in order to gain full efficiency of working; and the following notes compiled from the writer's experience with heating plant of this description may be of use. The cold-feed inlet to an exhaust-steam heater is usually worked by means of a butterfly type of valve admitting water from an overhead tank, or other convenient source of supply; this valve is worked by means of an arm from a ball valve regulated by the height of water in the water container at the base of the heater. The trouble which the writer has noticed in some types of heater is that this inlet valve is made too small, and if the capacity of the pumps is rather large the heater occasionally gets empty of water, and the pumps start hammering violently; for this reason the heater inlet valve should be carefully watched during periods of heavy load, until one is sure that it is of sufficient capacity to pass all the water required.

In plants using soda in order to soften feed water, the common practice is to arrange for a small supplementary pump to pump the soda or other boiler fluid into the top of the heater, so that it flows in with the inlet water. Alternatively a small overhead tank is arranged with a cock, which can be opened to the desired amount in order to let the soda run in, according to the desired proportion. Both these systems are wrong. In the first method, small pumps dealing with strong solutions of soda or boiler fluid are an endless worry, as they are constantly getting choked with deposits from the heavy solutions which they are handling, or giving trouble at the glands. The second method is, of course, only a rough attempt, as a tank with a cock cannot control the proper amount of flow of soda, with varying demands on the heater, and consequently various volumes of water passing. The writer recently fitted an attachment to a heater-detartariser, which answers far better in practice than either of the methods above described. Above the level of the heater was fixed a tank, fitted with a cock, on the handle of which was placed a prolongation or arm; the other end of this arm was coupled to the arm of the ball valve which controlled the main water inlet, so that when the main water valve opened wide the soda valve opened proportionately. In this way the amount of soda was at all times exactly proportionate to the amount of water passing.

The best method of regulating the amount of steam which has to be admitted to these heaters is to have on the main exhaust a T-piece. In the exhaust above the T-piece is fitted a butterfly valve; the steam will pass into the heater until it reduces velocity to such a point that it sets up a slight back pressure, and the valve in the main exhaust can be set to open at two or three pounds pressure, thus allowing the excess of steam which is not required by the heater to pass away up the main exhaust pipe.

Probably the most serious source of trouble in heater-detartarisers is the gradual accumulation of grease from the

engine exhaust, which, in course of time, settles in the trays and prevents the proper close contact of the water in the pools with the hot steam; in this way several degrees of temperature can be lost, and it is, therefore, necessary to fit some simple form of grease trap in the steam inlet before the steam enters the heater. The heater should be taken to pieces at least once every six months if it has been in anything like constant use, and the trays should be scraped out; these will be found, provided the detartariser has been working properly, to be filled with 1½ in. to 2 in. of slime and soft scale. The trays, as a rule, are not bolted together, but have surfaced-joint faces. Some makers recommend the use of glazier's putty as a jointing material, but the writer has found that this produces leaks and rots away very quickly, so that he prefers to use a thin layer of mastic.

Even in stations where the main engines are run on a condenser, a feed heater can very often be successfully operated by means of the steam from the feed pumps. It can easily be ascertained whether the best results are being obtained from the quantity of steam available by noting whether steam is to be seen issuing from the vent-holes at the top of the heater. The best condition of working is when the steam is just escaping in this way. If the pump exhausts are insufficient for this, it will in all probability pay to put a little live steam (that is, steam direct from the boilers) into the lower chamber of the heater. It will be found that very little live steam will be required to keep up the desired temperature, so that a ½-in. pipe furnished with a regulating valve will meet the case.

There is no doubt that the feed-water heater has quite a distinct place in central-station work, which, up to the present, has not been fully utilised. This is doubtless due to the essentially correct practice of condensing wherever possible, and of effecting the heating of the feed-water by means of economisers. As pointed out above, however, cases may arise where the cost of an economiser, as represented by interest on capital, may be somewhat in excess of the saving in heat, an effect more particularly possible in small stations; and in this case it is advisable to see whether a suitable arrangement of exhaust-steam heaters cannot be contrived.

Storage Battery in a Steel Works.—While the introduction of electric power for all purposes has revolutionised to a large extent the operation of modern iron and steel works, the economies which may be obtained by the use of a storage battery are not yet fully appreciated. There are many plants in which a large part of the electric power load is at a considerable distance from the generating station, where the installation of a suitable storage battery, floating on the line, at or near the local centre of distribution of the distant load, will produce excellent results. By increasing the load-factor it will effect a great saving in plant operation. It will maintain an increased and steady voltage at the load, and increase the plant output at far less cost than would be necessary for a new generating equipment. The Cambria Steel Works Co. uses a considerable amount of electrically-operated plant situated at a good distance from the power house. The momentary current values required vary from 400 to 4,000 amperes, equivalent to rapid fluctuations in load from 100 to 1,000 KW. at 250 volts. To meet the demands of an increase in load, it was found necessary either to add to the generating plant, or to relieve it of power fluctuations to such an extent that additional load could be handled by the existing units. It was found, as is often the case, that the installation of a storage battery near the centre of the load could be made at much less cost than an increase in the generating equipment. In addition, an increase in the load-factor would be introduced with consequently more economical operation. The battery required must, however, fulfil certain requirements. The voltage at the terminals from charge to discharge must vary within small limits only. It must be capable of carrying an occasional overload, and be able to stand fully discharged for short periods without permanent injury. The General Storage Battery Co.'s regular Bijur "High Duty" type was chosen to meet these requirements, and a battery of 106 cells was installed, having a discharging capacity of 2,400 amperes for 20 minutes. Each cell has 25 plates 15 in. × 15 in. These plates are burned to bars of rolled lead, except in the terminal cells, where the bars are provided with internal copper conducting reinforcements. The connections between adjacent rows of cells are made by means of lead-covered copper bar. A battery situated as this is, at a good distance from the power station, requires no regulating booster at the power house. The results obtained may be briefly summarised under the following heads:—(1) Saving in initial cost over generating equipment of equivalent capacity; (2) saving of 27,700 lb. of copper removed from feeders; (3) removal of fluctuations from the power station; (4) increase in working voltage; (5) reduction of feeder losses; (6) increase of station output from existing units; (7) creation of a reserve source of supply.

THE EFFECT OF TEMPERATURE ON TRANSFORMERS.

Some few weeks ago we gave an abstract of a paper embodying Canadian experience on the trials of the operating engineer, and it will be remembered that one of the principal points under discussion was the behaviour of transformers under extreme heat and extreme cold. From the discussion on this paper, further interesting points as regards transformer troubles were brought out, and it may be worth while to consider these.

It should first of all be remembered that in Canada transformers are worked under much more severe conditions than those existing in this country. The transmission lines are generally overhead; and where an extra-high-tension line is to be tapped for supplying a small town, it is the custom, rather than divert the pole line into the town, to take off a branch circuit at a pressure of about 2,000 volts; this branch main is taken through the streets of the town, which, of course, cannot be done with feeders at the main-line pressure. The transformers for this purpose are generally placed close to the main line, the smaller converters being fixed on the poles. Only in the case of large transformers are houses provided, so that these pieces of apparatus are generally exposed to the full rigours of the elements.

The following remarks about the effect of extreme cold on transformers only apply to extra-high-tension work; the apparatus which converts 2,000 to, say, 110 volts does not appear to incur any harm, probably because the factor of safety of the insulation is much higher. In cases where oil-cooled transformers are placed in the open air to obviate fire risks, and also in the case of consumers whose load is usually a summer one—the transformer being switched off during the winter—the question of the effect of low temperatures on the oil becomes of importance; and in the case of small transformers switched off for the winter, these should be removed and stored in the nearest covered depôt during the months of hard weather. Larger transformers—say, of 500-KW. capacity—are too bulky to be treated in this way on account of expense in removal, and before being put into commission after a spell of severe weather, they should be dried out on short circuit in order to restore the oil and to evaporate any moisture therein.

In the case of transformers tapping off an overhead line far out in the midst of country, the drying-out process would be difficult and expensive, and it would be better to leave the transformers in circuit all the winter and to put up with the no-load losses incurred.

All transformer oils precipitate paraffin, to a greater or lesser extent, under the influence of extreme cold. This precipitation has a two-fold injurious effect. First, it weakens the dielectric properties of the oil which remains fluid; and, secondly, most of the precipitate deposits on the coils of the transformer, and remains as a solid non-conductor of heat between the coils and the fluid oil. This causes over-heating when the load comes on again; the over-heating is caused, not by the paraffin being a worse heat-conductor than the remaining oil, but because it hampers the convection currents which carry away heat from the more strongly-heated points.

The effect of the opposite extreme—that of heat—is also injurious to oil-cooled transformers. In one or two cases immediate damage has not ensued even when the converters have been worked up to very high temperatures. In one case the transformer had been operated at a temperature of 200° C. for three or four weeks, but the oil in this case—which was a mineral oil of 235° C. flashing-point—had suffered. 300° Mineral Seal Oil (the trade name for a special hydro-carbon oil) is well known to give very little trouble either at high temperature or from deposits on the cooling coils at lower temperatures. At the same time, the consensus of opinion of Canadian engineers appears to be that it is a false policy to operate oil-cooled transformers at high temperatures, on account of the slow deterioration both of oil and windings which goes on.

PROCEEDINGS OF INSTITUTIONS.

The Heat Conductivity of Iron Stampings.

By Thomas Morgan Barlow, M.Sc., Student.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Birmingham, January 15th*, 1908.)

Coils which are embedded in iron (laminated) which has not sufficient cooling surface for the conditions agreed upon over-heat, and thus cause great increase in the resistance, and therefore lower efficiency. For the same reason the voltage regulation is bad, and the compounding of the machine is liable to be upset. Also the iron losses are increased with the rise of temperature. Continual overheating may also char the insulation, breaking it down, and thus causing a short circuit. These few points show especially that the iron part usually laminated and heated internally by hysteresis and eddy currents must be carefully designed as regards cooling surfaces. This can be most efficiently done if the heat conduction coefficient is known in all directions from the source of heat. Further, the maximum temperature to which any part of the machine may rise after a steady state has been reached depends upon two physical quantities, namely, the internal conductivity of the material in question, and the external conductivity or method of cooling.

Hence the main object of the research undertaken was to determine (1) the conductivity of heat in a direction parallel to the insulated iron stampings, and (2) the conductivity in a direction at right angles to the plane surface of the stampings, *i.e.*, across iron and paper (insulation).

No attempt was made to use artificial cooling by oil or forced draught, as the method employed did not lend itself to air cooling other than by the natural convection currents in the air.

Consider the case of a lamina or wall with parallel faces, one face kept at a fixed temperature θ_1, while the other is maintained at θ_2. If there be established a permanent state and uniform flow of heat, the temperature may be taken to fall uniformly if the wall be made of the same material throughout, and if the conducting power does not depend upon the temperature.

From first principles the quantity of heat which flows through such a wall is directly proportional to the difference of temperature $(\theta_1 - \theta_2)$ of its faces. The quantity of heat which flows through an area A of such a wall in time t seconds will be proportional to A and t; also if Q be the quantity of heat, a the thickness of the wall, and K be the heat conduction coefficient, depending upon the nature of the substance and numerically equal to the quantity of heat which flows per unit time through unit area of a plate of unit thickness having unit difference of temperature between its faces, then—

$$Q = K \cdot \frac{\theta_1 - \theta_2}{a} A t.$$

(The units are Centigrade and C.G.S.)

Now consider the flow of heat through a circular lamina heated from the inside. This corresponds to the actual case of the experiment. Let the temperature at a distance r cm. from the centre

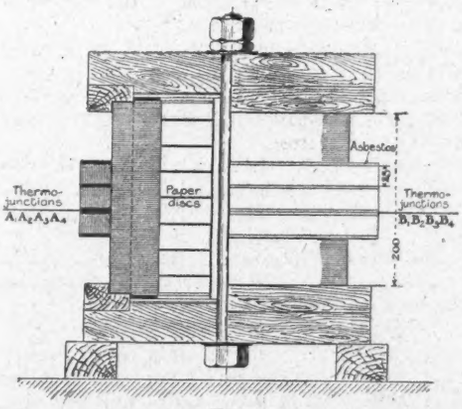


Fig. 1.—Section and Elevation of Apparatus.

be θ_r and at a radius $x + r$ be θ_x; if the temperature difference between the two points be denoted by θ, and if l cm. be the length of a cylinder built up of stampings or laminæ, the surface of the cylinder being the total cooling surface, then—

$$\theta = \frac{1}{K} \frac{Q}{2\pi l} \log_e \left(1 + \frac{x}{r}\right).$$

From this formula the values of K for iron stampings, both in the direction parallel to the plane surface of the stampings and across the iron and paper at right angles to the surface, were calculated.

If K_s be the heat conduction coefficient for iron laminations in a direction parallel to the surface of one stamping, and K_t in a direction at right angles to this surface, *i.e.*, across iron and paper or insulation, then their ratio $= K_s/K_t$.

If C equals the ratio of the sides of two square surfaces, one being the edge surface of a packet of stampings and the other being the plane surface of the outside stamping of the packet, and if both these surfaces are made to dissipate the same amount of heat, *i.e.* equal cooling, then—

$$C = \sqrt{K_s/K_t}.$$

To obviate the difficulty of calculating the heat leakage if the iron stampings were heated on one side, a cylinder built up of stampings was used, being heated on the inside edge and cooled on the outside (see fig. 1). This was built up of stator stampings made by Messrs. Sankey & Co., Bilston, 0·0345 cm. thick, and insulated with a preparation known as "Insuline." The plates were firmly clamped together, and the slots wound with ten turns of D.C.C. copper wire round each tooth, giving twenty turns per slot. The slots were insulated with paper tubes built up by rolling cartridge paper stuck with shellac varnish round a former. The thermo-junctions for the core were fixed between two fine sheets of condenser paper cut to the same shape as the stampings, the two leads of each junction being carefully brought out, so that there was no fear of short circuit. The stampings were clamped together between two wooden rings by means of a bolt and two heavy cross-pieces. The wooden rings were insulated with asbestos from the iron stampings. To prevent the iron bolt from getting hot, and so allowing the nut and head to dissipate heat, the air inside was divided off into sections, so as to localise the heat currents, by means of disks of paper. The bolt was also shielded by a paper tube. The top and bottom of the core were insulated also with asbestos sheet, cord and cotton waste. These precautions practically ensured that all the power supplied to the windings would be dissipated in heat from the outside edge surface of the stampings.

For the second part of the work—*i.e.*, the measurement of the heat conductivity across iron and paper, iron strip was wound over the outside of the cylindrical core, each layer being interleaved with paper. The strip was 2·5 × 0·05 cm., and was of best soft steel of bluish colour. The paper was 0·005 cm. thick. Three coils were wound, the thermo-junctions being placed at suitable intervals

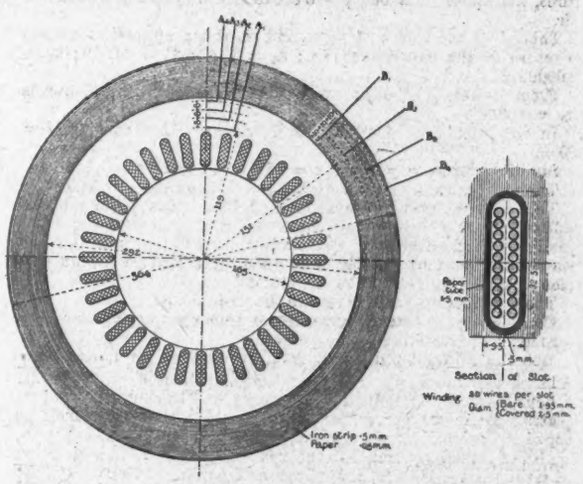


Fig. 2.—Section of Core and Strip, Showing Positions of Thermo-junctions (all Dimensions in Millimetres).

in the centre one, and the two outside rings acting as guard rings. The coils were insulated with asbestos sheet from each other, and the edges of the two outside coils were also insulated from the air with asbestos sheet rings.

The position and method of carrying away the leads of the thermo-junctions are shown in fig. 2. In the core A_1, A_2, A_3, A_4 were placed 8 mm. apart. In the strip B_1, B_2, B_3, B_4 were 10 mm. apart, giving a total distance between A_1 and A_4, B_1 and B_4, of 2·4 cm. and 3 cm. respectively. After the strip had been wound on it was found that A_3 and B_3 had become short-circuited or broken. As this could not be remedied without dismantling the whole apparatus, readings were only taken from the six remaining thermo-junctions, these being quite sufficient for calculating the results required.

As the temperature was only to vary from 15 to 80° C., a new combination of metals was tried for a thermo-junction, and was found to give a straight line between the above limits. The two junction wires were—

Positive (+), No. 40 German silver silk-covered.
Negative (−), No. 32 pure silver wire bare.

The micro-voltage per 1° C. rise of temperature was 12·73.

The method of carrying out a test was as follows:—

The core was heated up for 18 hours by passing through the heating coils the current necessary to give the watts required. Connection was then made through one of the junctions, the shunt, and the galvanometer. The galvanometer mirror was then brought to zero by passing a current through the shunt in the opposite direction. This was very finely regulated, giving the current through the shunt, and so the micro-volts for any particular junction, hence the temperature of the iron at the point where that junction was fixed.

The micro-volts A_1, A_4 were first taken. Then B_1 and B_4, and finally A_2 and B_2. The whole set of readings was repeated three times and the average taken if there was any slight variation. The instruments were all millivolt-ammeters by Siemens & Halske, and

were used with suitable shunts. The main resistance, carefully calibrated, was made by the same firm, and was of 0·0005 manganin. The regulating resistances were of the ordinary wire type of 42 ohms and 31·5 ohms respectively. A carbon resistance, which was always kept tight during the tests, was placed in the circuit for final adjustment.

Consider the flow of heat across one lamina of iron and one of paper in a direction at right angles to the surface. If Q be the total amount of heat across both iron and paper, θ the total drop of temperature, and K_b be the conduction coefficient for iron and paper interleaved, d_1 thickness of iron, d_2 thickness of paper, then—

$$Q = \frac{K_b \theta}{d_1 + d_2}.$$

From this it can be shown that—

$$\frac{d_1 + d_2}{K_b} = \frac{d_1}{K_1} + \frac{d_2}{K_2}.$$

If we reckon that the iron and paper do not fill the entire distance, but have very small layers of air between (this is actually the case), and if K_3 and d_3 are the conductivity and thickness of air, then similarly—

$$\frac{d_1 + d_2 + d_3}{K_b} = \frac{d_1}{K_1} + \frac{d_2}{K_2} + \frac{d_3}{K_3}. \quad \ldots \quad (1)$$

In the experiment, $d_1 = 0{\cdot}05$ cm., $d_2 = 0{\cdot}005$ cm., $d_3 = 0{\cdot}00125$ cm. (d_3 is worked out from the fact that 53 laminæ of iron and paper took up a distance of 3 cm.)

The following are values of K used for iron, paper, and air (C.G.S. and Centigrade units): K_1 iron = 0·1528 at 28° C.; K_2 paper = 0·0003; K_3 air = 0·0000479 at 0° C.

From the formula for variable conductivity $K = K_0(1 + a t)$, the correct conductivity was calculated for the approximate temperatures, the values of a being — 0·000282 for iron and + 0·0013 for air.

This gives the values of K_1, K_2 and K_3 at the approximate temperature of the experiment, *i.e.*: $K_1 = 0{\cdot}152$; $K_2 = 0{\cdot}0003$; $K_3 = 0{\cdot}0000528$.

From formula (1) the theoretical value of K_b from these figures is $K_b = 0\ 00138$.

In the calculation for K_a, $x = 2{\cdot}4$ cm., $r = 11{\cdot}9$ cm. and $l = 20$ cm.

Similarly for K_b, $x = 3$ cm., $r = 15{\cdot}1$ cm., $l = 20$ cm.

The average values obtained are $K_a = 0{\cdot}1405$ and $K_b = 0{\cdot}00137$.

This gives an average value of C of 10·1. Hence the ratio of sides of square edge and plate surfaces of iron stampings for equal cooling averages about 10. In actual practice the pressure on the stampings would be slightly more than that used in the experiment. This would lower the value of C by raising K_b a little.

The temperature-drop curves are shown in fig. 3.

Considering the case of a packet of iron stampings heated internally by hysteresis and eddy currents,

Let the mid-point distance from either face be t, and λ = calories generated per cubic centimetre; then $\theta = \lambda t^2/2 K_a$. λ depends upon the induction, frequency and thickness of the iron plates. Therefore curves can be drawn for various inductions showing the temperature gradient for any length of heat path, both in a direction parallel to the iron stampings, and in a direction at right angles—that is, across iron and paper—since $C = \sqrt{K_a/K_b}$ is known. The values of P_i—*i.e.*, watts lost per kilogramme corresponding to any particular induction—are taken from tables published by Sankey & Sons, Bilston, for their "Stalloy" iron stampings 0·35 mm. at 50 cycles.

B (lines per cm.²) (induction).	P_i (watts lost per kg.).
5,000	0·64
6,000	0·84
7,000	1·08
8,000	1·32
9,000	1·56
10,000	1·87
11,000	2·15

From the table we can obtain the loss in watts per kg. = P_i. This reduced to calories per cubic centimetre = $\lambda = P_i/540$.

$$\therefore \theta = \frac{P_i}{540} \cdot \frac{t^2}{2 K_a} = \frac{P_i t^2}{152},$$

the average value of K_a being 0·1405.

The curves (fig. 4) are applicable to the flow of heat across iron and paper by using the upper scale, which is one-tenth the bottom scale, C being taken equal to 10.

After the completion of tests as above the iron strip and paper were removed. The core was then heated up to various degrees and the temperature noted by means of the thermo-junctions. Two series of tests were conducted:—(1) Still-air cooling; (2) moderate blast cooling. The latter was obtained by sending a blast from an ordinary ventilating fan round the core.

If P watts be supplied to heat the core and S be the cooling surface in sq. cm., the specific cooling surface σ (defined as the number of sq. cm. allowed per watt) = S/P.

The temperature rise can then be expressed approximately by the formula: $T = C'/\sigma$, where C′ is a coefficient. If C′ were constant a curve showing the variation of temperature with the specific cooling surface would be a hyperbola. The coefficient, however, varies slightly, but for ordinary calculations the value for C′, which gives a hyperbola closely approximating to the actual cooling curve, may be taken (fig. 5). The hyperbolas drawn are the nearest to the two curves for cooling by still air and moderate blast. Their equations are:—

Still air ... ... $T = 650/\sigma$
Moderate air blast ... ... $T = 300/\sigma$

It will be noticed that for still air the theoretical hyperbola does not lie very well on the curve obtained by experiment. This is due to the convection currents which are set up in the still air by the

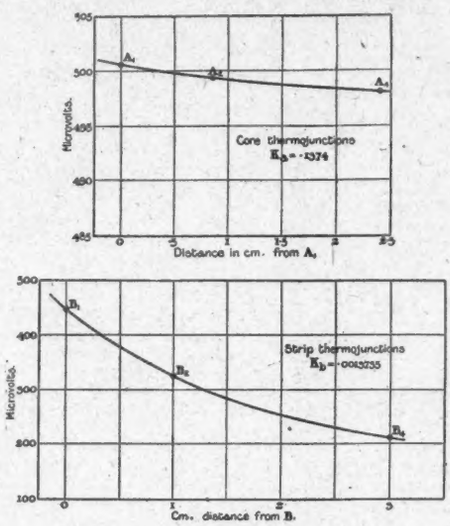


FIG. 3.—TEMPERATURE CURVES.

dissipation of the heat. In the case of the strong air blast these have no effect. Hence the theoretical hyperbola, $T\sigma = 300$, more closely approximates to the actual curve obtained.

The main conclusion to be drawn from the values of the heat conductivities of iron insulated stampings found for a heat path (1) in a direction in the same plane as the plate surface of the stampings, and (2) in a direction at right angles to the stampings (across

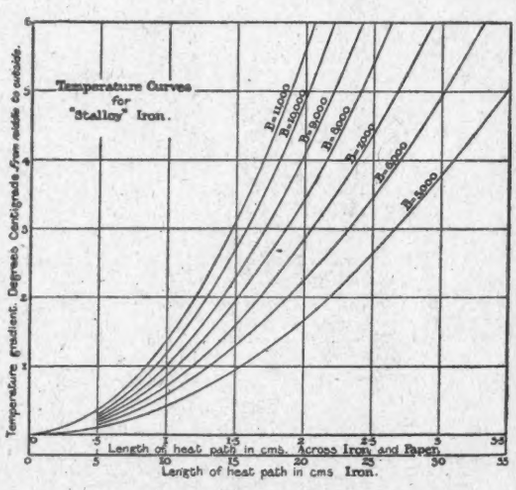

Temperature Curves for "Stalloy" Iron.
Temperature gradient. Degrees Centigrade from inside to outside.
Length of heat path in cms. Across Iron and Paper.
Length of heat path in cms Iron.

FIG. 4.

iron and paper), is the importance which must be given to the amount of edge surface of the stampings of a laminated iron core exposed to the cooling medium, either air or oil.

It is seen from fig. 4, which may be drawn for any iron stampings of which the hysteresis and eddy-current losses are known, that the temperature gradient will be almost a straight line in a direction with the plane of the stampings. Thus the internal temperature of the core is quickly reduced if the method of cooling employed, either air or oil, is used on this edge surface. On the other hand, if the iron laminated core is only cooled on the plate surface, the temperature will rise, comparatively, very rapidly as the core is penetrated across the iron and paper. This rise amounts to as much as 5° C. for a distance of 2 cm. for an induction of 10,000 lines per cm.² at 50 cycles in the iron for which the curves are plotted. The effect of this steep temperature gradient in an iron core thus cooled is the increase of the hysteresis loss in the centre portion due to the decrease of the permeability of the iron with the rise of temperature. Also for any iron rectangular laminated core, which is heated internally, from the values of $C = \sqrt{K/K_b}$, the ratio of the linear dimensions of the sides of the core, *i.e.*, edge side to plate side, for the most efficient cooling must equal 1 : 10. This ratio is somewhat higher than is used at present in common

practice, the figure averaging about 1 : 6 for small armature cores and transformers and 1 : 7·5 for large cores.

Further, dealing with the question of the ventilation of direct-current armatures, it will be noticed that the ventilating ducts between the packets of iron stampings are not so useful on account of the extra plate surface exposed to the cooling draught induced, but act more as an outlet for the air inside the centre space of the

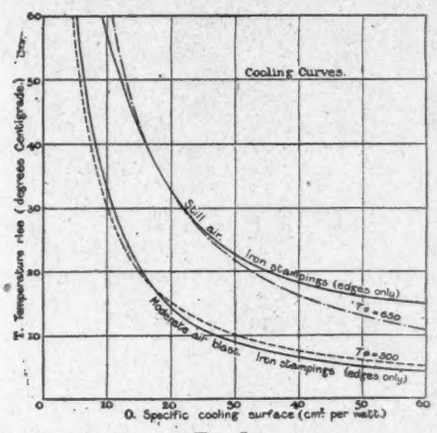


FIG. 5.

armature, which has been heated in cooling the inside edge surface and so the internal parts of the core. This also applies to the ducts in large transformer cores cooled by a direct air blast.

In connection with the few tests for cooling coefficients for iron cores, these formulæ may be used for the temperature rise (surface) of the iron core of a transformer, where the effective plate surface for cooling, in comparison with the edge surface, can be neglected. Values of the coefficient may be approximated for different rates of air cooling, but further work is necessary on this part of the subject before any definite conclusion can be inferred.

DISCUSSION.

DR. W. E. SUMPNER said that the results obtained should prove valuable. It was stated in the paper that c^2 was the ratio of conductivity along the stampings to the conductivity across the stampings. This formula was quite true if the temperature gradient was the same in each direction. Inside the core the heat flow was quickest in the direction of the greatest gradient. On the outside surface, however, a unit of area dissipated equally whether it was edge-on or face-on. The temperature excess of the outside surface over the air was therefore different for different portions of the surface, and the ratio of which he spoke depended consequently upon shape and dimensions. The discrepancy referred to on the last page of the paper could be explained in this way.

MR. LINDSAY FORSTER (Birmingham) asked the author whether the heat did actually come out of the stampings as assumed in the paper. Were the wood ends which were used in connection with the testing apparatus sufficient insulation against heat leakage? He knew an example in which the cooling of the armature iron was effected solely by edge conductivity.

DR. D. K. MORRIS (Coventry) objected to the statement that the iron loss increased with the rise of temperature. Losses due to both hysteresis and eddy currents decreased with increase of temperature.

PROF. KAPP explained that the increased loss referred to by Mr. Morris was a secondary effect arising from a change in the flux distribution, as explained in the paper. He said that some time ago at his suggestion the committee of the German Institution of Electrical Engineers had voted a sum of money to Prof. Linde to carry out experiments on the subject. In these experiments, which were done on packets of plates and paper, one face was heated with hot water and the other cooled with melting ice, a number of precautions being taken, the necessity for which had been pointed out by Mr. Forster. The work had been in progress two years, and as a preliminary result, Prof. Linde had given the value of the constant c^2 as 80. But this result had not been confirmed, so he had suggested to Mr. Barlow that he should investigate the subject, using an apparatus which would approach more nearly to standard conditions. A question raised by the paper was—Is the flat surface of a packet of stampings of any real value? In order to get a clearer idea, he had worked out the value of the combined or total surface in terms of the edge surface for different shapes of packets.

Ratio $\frac{\text{Flat surface}}{\text{Edge surface}}$ =	1	2	3	4	5	7	10
Factor expressing value of total surface =	1·01	1·04	1·09	1·16	1·25	1·5	2

In practice it was customary to make packets about seven times as long as thick. Theoretically this should be 10, but such a ratio would lead to waste of room, so that seven was not a bad compromise. In reference to Mr. Forster's remarks, it was quite possible that the wood ends used with the apparatus did not entirely prevent the flow of heat; but, in any case, the flow of heat was all right on the median line. He had no doubt that the experiments were substantially correct. Mr. Barlow's figure for c^2 was 100, as compared with Prof. Linde's 80. The difference was probably due to the amount of end compression on the stampings.

Cost of Electrical Power for Industrial Purposes.

By JOHN F. C. SNELL.

(*Further discussion on paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS. *See* ELECTRICAL REVIEW, *January 24th*, 1908, p. 155).

MR. W. B. ESSON, London, in a communication, pointed out that much of the ground traversed by the paper was covered by his address on "The Industrial Power Problem" to the Civil and Mechanical Engineers' Society in October, 1906, and that Mr. Snell arrived at practically the same conclusions. In the address referred to, the cost of electrical power for a factory which could be served by an engine of 500 B.H.P., 25 per cent. load factor, was given as follows:—

	Mond gas.	Suction gas.	Steam, cond.	Steam, non-cond.	Oil.
Total cost per unit...	·516d.	·564d.	·513d.	·536d.	·592d.

The figures given by Mr. Snell in Table II for a load factor of 25 per cent. were:—

	Mond gas.	Suction gas.	Steam, cond.	Steam, non-cond.	Oil.
Total cost per unit...	—	·670d.	·590d.	—	·584d.

Mr. Snell's figures were somewhat higher, because he averaged the cost of plants between 100 H.P. and 500 H.P., whereas his (Mr. Esson's) were for the higher output. The agreement was sufficiently close, however, to show that under ordinary circumstances the total cost would lie somewhere between ·5d. and ·6d. per unit.

Mr. Snell remarked that in Sunderland, at the time of the last census, "there were 587 motors, representing a total H.P. of 1,634, or an equivalent to 1,220 KW. The maximum demand on the station plant was only 500 KW. There was thus a diversity factor of 2·4." With this he disagreed. Properly, the magnitude of the diversity factor expressed the degree to which the load factor was improved by the diversity in the hours of demand in the industries supplied, and it could only be determined by ascertaining the ratio of the *sum of the maximum demands of all the factories served* to the maximum demand on the power house. If it was found that the former was 50 per cent. greater than the latter, the diversity factor = 1·5, because the load factor on the power house was one-half better than if there were no diversity; if 100 per cent. greater, the diversity factor = 2, because the load factor was twice as good; and so on. The diversity factor could not be got at by taking the sub-station loads, as Mr. Snell had done, for the simple reason that at each sub-station the demands of all the factories served therefrom were already averaged up. It was quite possible that, though the real diversity factor was very large, the sub-station to power house ratio might be *unity*. Mr. Snell, under a misapprehension, again referred in this connection to the H.P. of the motors simultaneously running as compared with the total H.P. installed; but this had nothing to do with either load factor or diversity factor, if to those terms were assigned their proper meanings.

Mr. Snell said that "in fixing maximum scales it is wise always to base the *maximum* rates upon a diversity factor of unity"; but this simply meant that, to begin with, some particular load factor must be assumed which, it was hoped, diversity would improve later on.

He heartily agreed with Mr. Snell's remarks in Section IV as to prices. There was no doubt whatever that, for a big increase in the amount of power supplied by the companies at the same rates, it would be found that the total receipts were not commensurate with the total costs.

DUBLIN, JANUARY 9TH.

MR. T. TOMLINSON, referring to the load factor, said that his own definition of it was:—The total units generated per annum divided by the possible units which the plant (excluding spares) could generate in one year of 8,760 hours. The *Electrical Times*' definition, which used the maximum demand on feeders over 8,760 hours as the divisor, took no account of the total capacity, upon which capital charges very largely depended; in many cases plant capacity was twice full-load capacity. He had himself a series of figures worked out in connection with the Dublin and Central Ireland power scheme. He assumed a central station of 5,000-KW. capacity, consisting of five gas engines driving three-phase units each of 1,000 KW., one being assumed as spare, and took two cases of supply, one close to the station and the other 27 miles away. The maximum working kilowatts of such a plant would be 4,000 KW. The capital cost was found to be £17 5s. per KW. installed. Therefore, the capital cost per working KW. was £22, say; to this was added £4 per working KW. for reducing transformers and switchgear, and £5 per working KW. for the cost of getting the Act, engineering, &c., making a total of £31 per working kilowatt. The cost of a double overhead line was found to be £6 5s. per working KW., at 30,000 volts. The cost of operation of the system, including office charges and directors' fees, but excluding fuel and line charges, was found to be £6,600, or £1·65 per working kilowatt. The cost of operating the line, including wayleaves, was found to be £0·26 per working kilowatt. If now he assumed that he required to earn 10 per cent. on his capital, then every kilowatt must earn per annum, interest on cost at 10 per cent. plus cost of operation, plus

cost of fuel. In the case of supply close to the station, and, therefore, with no appreciable cost for transmission, this earning power per working kilowatt must be:—

Interest on capital cost = 10 per cent. on £31	= 744d.
Cost of operation = £1·65	= 396d.
	1,140d.

or assuming a loss in conversion of 10 per cent., 1,266d. This sum of 1,266d. could be earned by the kilowatt operated throughout the 8,760 hours of the year (load factor 100 per cent.), in this case the cost per unit would be $\frac{1266}{8760}$ = 0·145d., to which cost of fuel was to be added. In this case the "diversity factor" must be unity, and if he assumed this condition throughout, then the cost per unit to any consumer was got by the simple formula:—1,266 = hours demand × price per unit. In the case of transmission to a distance the earning power must similarly be:—

Interest on capital cost = 10 per cent. on £37·5	=	900d.
Cost of operation ... =	£1·65	= 396d.
Line charges... ... =	£0·16	= 62d.
		1,358d.

or allowing 20 per cent. for conversion and loss in line, 1,698d. The cost per unit for 8,760 hours (load factor 100 per cent.) would, therefore, be 0·194d., to which the cost of fuel had to be added. For any other load factor the cost per unit would be:—1,698 = hours demand × pence per unit, "diversity factor" being assumed, as before, unity. The actual resulting figures were:—

Annual load factor.	Close to generating station.	27 miles from generating station.
10 per cent. ...	1·444d. ...	1·940d.
20 „ ...	0·731d. ...	0·970d.
30 „ ...	0·486d. ...	0·646d.
40 „ ...	0·364d. ...	0·484d.
50 „ ...	0·291d. ...	0·390d.
60 „ ...	0·243d. ...	0·323d.
70 „ ...	0·208d. ...	0·226d.
80 „ ...	0·182d. ...	0·242d.
90 „ ...	0·162d. ...	0·215d.
100 „ ...	0·144d. ...	0·194d.

In this particular case no addition need be made for fuel, as the value of the sulphate of ammonia recovered was known at least to cover the cost of peat used; the amount per unit was, however, estimated for each load factor, and varied from 1 ton of peat per 760 units at 100 per cent. load factor, to 1 ton per 540 units at 30 per cent. load factor, and in the ordinary course the money value would be added to the cost of the unit. The diversity factor, where operative, *i.e.*, at the lower load factor, reduced the cost per unit.

MR. M. RUDDLE said he did not agree that those undertakings who were already supplying cheap power would eventually reach a financial crisis; the addition of a power load had in many cases resulted in a wholesale reduction in costs, which had reacted favourably on both lighting and power consumers. Nor did he agree that the higher efficiency lamps would result in a diminution of output for lighting purposes. In Dublin the metallic filament lamp had been largely adopted, and their experience was that consumers seized upon this lamp rather with a view to increasing their lighting than reducing the quarterly accounts, and, in addition to this, it should be noted that the cheapening of electric light would mean the addition of many new consumers who were at present holding off owing to the question of cost. Mr. Ruddle considered that the capital cost of the system outlined by Mr. Snell, would be far in excess of £25 per KW., which rather upset the author's figures. The paper was apparently directed against the London undertakings, and in favour of the large scheme formulated by the author and his colleagues for the concentrated scheme of supply. The speaker, however, very much doubted the wisdom of concentration, and thought the division of risks among a number of undertakers and generating works to be the sounder policy. Lastly, due credit should be given the present undertakers for the enormous business which they had collected. The capital expenditure had been incurred, as mentioned by Mr. Snell, and must be duly considered in formulating any new scheme.

MR. P. S. SHEARDOWN thought it curious that the Newcastle Electric Supply Co., which was the largest power company in existence, had spent £59·6 per KW. on its system if the author's figure of £25 per KW. was correct. It was a fact that this company had been the means of closing down a great number of private plants—some of considerable magnitude; therefore he considered that in certain districts there was an opening for external power supply, although the figures which Mr. Snell had given regarding the running costs of private plants rather tended to negative that view.

MR. L. KETTLE suggested that if Mr. Snell's premises were correct, nobody would be found willing to purchase power at the prices Mr. Snell thought it necessary to charge.

MR. W. J. SOWTER was in cordial agreement with Mr. Snell in his suggestion that it was unnecessary to convert three-phase A.C. to direct-current, and had been surprised to find that in several cases of towns being supplied in bulk, the distributing authority had gone to the expense of installing rotaries, batteries, and so forth, thus increasing the capital cost and reducing the efficiency of distribution. He knew of several cases in which power users supplied at 1d. per unit, had decided to install their own generating plant, one being a large firm with a maximum demand of some 600 KW., and another, a small engineering undertaking, having some 75 H.P. of motors. It, therefore, behoved the managers of supply undertakings so to equip the latter, that they were in a position to supply energy profitably at the lowest possible rates.

GLASGOW, JANUARY 14TH.

MR. ROBERTSON (Glasgow) opened the discussion. He thought that the basis upon which the prices were given was too low—particularly in the case of Tables I and II. The author pointed out that the examples given in the second conclusion of the paper were in most cases higher than those tables; but he thought that the difference between these was so enormous that it could not be passed over. Taking suction gas plant from 85 to 175 B.H.P., the average cost for the whole generating plant varied from £13·25 per H.P. to £14, rising to nearly £20 on making allowance for foundations and buildings. Another plant, a Diesel engine of 270 H.P., came out about £15 10s., and including foundations and buildings about £20 per H.P. A similar plant of 400 H.P. worked out at £13 5s. The most reasonable method of charging was, he thought, by so much per kilowatt per annum, with the addition of a small amount per unit. They had not yet had sufficient experience in this country to enable the companies to come to a definite decision as to the limit of distance.

MR. SPARKS referred to the work carried out in South Wales, as mentioned in the paper, where the cost was, with plant of 3,000 KW., £11 and £12. He had also been associated with private installations of 1,500 KW., and the cost there was the same.

MR. ROBERTSON (Greenock) said, as to private and public plant, he had had the greatest difficulty in getting accurate data, and when figures were given as to cost of generation, he had found, on investigation, that they were utterly unreliable. The shipyard load factor was a particularly bad one; the uncertainty of the demand, due to weather, fluctuation of trade, and other causes, was such as they did not get in an ordinary factory. He had seen half a dozen private stations shut down during the last few years owing to the public supply.

MR. LACKIE said that the load factor of an ordinary hoist motor in a city was under 9 per cent., but by all the hoist motors in the city getting their supply from one source, the supply authority was enabled to give the hoists energy at a rate per unit corresponding to at least a 20 per cent. load factor. The same reasoning must apply to the industrial user, and therefore it appeared to him that a maximum price for electrical energy for power or industrial purposes might be fixed at a price corresponding to 20 or 25 per cent. load factor, and the price thereafter should be made to meet a better load factor than 20 or 25 per cent. The 10 per cent. load factor users could not generate power at a rate to compete with a 20 per cent. load factor, if all considerations were taken into account. Ascertained costs were given for power generated by independent installations. The outstanding fact in the figures given was that the cost of steam was less in every case than the cost of suction or producer-gas plant. That was contrary to all the data that had been put before him. The example given of a gas plant had apparently a serious error in its capital cost. It was stated that interest and depreciation would amount to £60 for four months, or £180 for a year, so that the capital cost of the plant would be £1,800, or £8 2s. per kilowatt. He was certain that that plant was never put down for £8 2s. per kilowatt, and in support of that would point out that in every other case stated by the author the cost ran between £15 and £20 per kilowatt. On the same page it was stated that the gas consumption was 36 cb. ft. per kilowatt-hour—a large figure even on so low an annual load factor as 14 per cent. He was of opinion that the annual load factor had nothing whatever to do with the gas consumption, but only the plant load factor, and as the plant load factor was 48 per cent., the only conclusion that one could come to was that 36 cb. ft. per kilowatt was about the average figure that one got with gas engine plant, instead of the figure of 15 to 20 cb. ft. quoted by gas engine makers. It really amounted to this—that the cost of gas per unit, with gas at 2s. 4d. per 1,000 cb. ft., was about 1d. In all the examples stated, of course, Mr. Snell had not allowed for land and buildings, or rent, rates and taxes. The colliery load-factor might be looked upon as about 36 per cent., and in steel works and other similar works, the annual load-factor was about 20 to 25 per cent. But it must not be forgotten that with a public supply they were able to offer a consumer having an annual load-factor of 20 to 25 per cent., a rate corresponding to a load-factor of about 40 per cent., owing to the fact that some of the plant which was used during the day to supply the day consumer was also used during the night for supplying some night consumers. The author stated that the average load-factor in Sunderland was 10 per cent. He had added up the horse-power installed and the annual units, and found that allowing for a diversity factor of 2·4, 2,000 KW. of plant supplied 5 million units, and thus they had a load-factor of something like 30 per cent. It was of interest to note that the Newcastle charges with their capital cost of £59·6 per KW., compared favourably with the theoretical London County Council figures, with an alleged capital cost of only £25 per KW. The fact was that the horse-power of motors installed in a factory had a diversity factor of about 2, and the result of an individual diversity factor of 2 divided amongst all the consumers, gave a diversity factor on the station of about 3. In the tramway supply the diversity factor was about 10, *i.e.*, for every 100 KW. of motors, only 10 KW. of maximum demand was made upon the power house. Hoists had about the same diversity factor as a tramway supply, and each trade had its own diversity factor. Probably the worse the load factor the greater the diversity factor. Mr. Snell advocated that the supply should be alternating-current taken from

static transformers, but he never mentioned the effect of transformers on his power factor, and the wattless current and the loss in cables, which was a very serious matter. Further, it was advocated that works having 100 KW. or more should each have their own local static sub-station. That would add tremendously to the cost per kilowatt, and the cost quoted would be probably doubled. Mr. Snell said, after boldly stating that many London companies were selling energy under cost price for power purposes, that "this means that the power user is being supplied by these undertakings at the expense of their lighting consumers, who pay an unduly high rate for their supply, or in the case of certain London municipalities at too high rates for public lighting." He had written the word "bunkum" after that. If it were not for these power consumers, in Glasgow at least, the coal consumption would be about 7 lb. per unit, whereas it was under 4 lb. If it were not for this sale of energy for power purposes, they would require something like ½d. per unit more for lighting to make up for the difference in coal consumption. Mr. Snell did not indicate in any way whatever how he arrived at the correct charge to be made by the London local authorities and larger municipalities, and he did not at all agree with the figures given for Glasgow. On page 24, the average and mean columns simply represented the mean of the five figures given in the five columns. Now the probability was that in Manchester there were ten times the units consumed that there were in Nottingham, and consequently to get the true mean one would require to take the number of units sold at 5d. and the number sold at 4·9d. in Nottingham and similarly with Leeds and Glasgow, and so get the true mean or average. The conclusion of Mr. Snell's paper was a most unfair one. He stated that looking back it would have been much wiser if the authorities —viz., the Local Government Board and the Board of Trade—had prevented some of the smaller local burghs from adopting separate electricity stations. He did not agree with that statement at all, for if the Local Government Board and the Board of Trade had not allowed the smaller local burghs to do so, a company would have stepped in and done the work, and the companies would have been in no better position to-day than these small local burghs. Further, these local burghs had done pioneer work and given a supply while the demand for electrical energy was growing and the public being educated to its use. He was afraid also that the remedy Mr. Snell suggested would not prove a beneficial one to the power companies although it was quite correct. These smaller local burghs would only call upon the power companies to supply their peak load in the winter months, and instead of a load factor of 30 or 40 per cent. it would be more like 2 or 3 per cent. for some years to come.

The Electrification of Railways.

ON Saturday afternoon last, 25th inst., at the Royal Institution, PROF. GISBERT KAPP delivered the second and last lecture of the series on "The Electrification of Railways." The first lecture was given on the 18th inst., and was reported in these columns last week.

In opening, the lecturer dealt at some length with the American lead in continuous-current working. Twenty-two years have passed since the first American line was run electrically, and since that time progress has been rapid.

Statistics in regard to main line electrical operations are difficult to obtain. Mr. Frank J. Sprague, in a paper recently read before the American Institute of Electrical Engineers, gives some figures in relation to the progress already made in the United States. The total value of stock, bonds and other obligations in connection with steam railway work is 2,760 million pounds, whilst in connection with electrical undertakings the corresponding figure is already 700 million pounds. After deducting even a large allowance for tramways from the latter figure, it will be seen that progress in main line electrification has been considerable. Further, we can reasonably infer that this large amount of money would not have been spent had not the economic and general superiority of electrical working been well demonstrated in the early stages.

The work of American engineers has been very largely on continuous current lines, but Continental engineers have been loath to follow too readily, for they have realised that continuous-current work is but a stage in the path of development and not a final solution.

In continuous-current work improvements have recently taken place along the following lines:—(1) The introduction of commutating poles; (2) The use of higher pressures; (3) The introduction of the gearless motor. The first mentioned has practically eliminated commutator troubles, whilst the last has rendered a much simpler type of locomotive, or motor-coach as the case may be, possible. The last two developments have been embodied in some locomotives built for the New York Central Railway by the General Electric Co. The motors in this case are gearless two-pole machines with the armature and field electrically, but not mechanically, connected. The armatures are mounted directly on the axles whilst the field magnets form part of the locomotive frame-work, and are free to move relatively to the armatures. As they are two-pole machines, their structure readily admits of the use of a higher voltage than usual. In these motors it is 650 volts. Each locomotive has four motors, of 550 H.P. each, and weighs 95 tons in all. The maximum draw-bar pull is 15 tons, and it is stated that they have displaced steam locomotives weighing 160 tons each.

The lecturer pointed out the desirability of the use of as high a voltage as possible, both in order to make very heavy currents unnecessary, and also to render the collection of the current easy.

For continuous-current work a voltage of from 500-600 is usually adopted, and if a much higher pressure is desired, the motors must be run in series. On the City and South London Railway a higher voltage is used in the feeders, but by means of a system of three-wire working, the voltage on the tracks is reduced to 550. For short lengths of line and for City traffic, where an evenly-balanced system is easily maintained, this method is eminently satisfactory, but for long-distance work the uneven balance and consequent large return currents make it undesirable.

The Krizik system, which is a development of the three-wire principle, was next referred to. In this there are two overhead trolley lines, one being positive and the other negative, whilst the running rails act as the neutral wire. The total pressure between the outers is 3,000 volts, and, consequently, the positive line will be 1,500 volts above, and the negative line 1,500 volts below, earth potential. Two sets, of two motors each, are placed in the locomotives, and each motor is wound for 750 volts. At starting the four motors are put in series between the negative and neutral, and at full speed the motors are connected, one set, in series, on the positive side, and the second set, in series, on the negative side of the neutral.

A typical type of American line was next described, having a 60,000-volt three-phase transmission line from power-house to sub-stations, whence, by means of static transformers and rotary converters, a low-pressure continuous-current supply was distributed to the track. In the towns a "door-to-door" service is becoming popular, and even on this part of the system a speed of 24 miles per hour is usual.

In England the work of electrification has been confined chiefly to short-distance lines. The Mersey Tunnel line, which was electrified by the British Westinghouse Co., is on the third and fourth rail system. A fourth rail is also used on the Metropolitan and District and other lines, as the working currents are too large for satisfactory transmission from the wheels to the running rails.

So much has already appeared in the technical Press on the various electrically-operated lines in England, that it is unnecessary to give a full account of Prof. Kapp's references to them.

For examples of three-phase work it is necessary to look abroad, and perhaps one of the oldest and most instructive lines thus operated, is the Burgdorf-Thun line in Switzerland. It has falsified nearly all that was said about it by many adverse critics, and, in spite of several technical drawbacks, including a low power-factor and little or no speed regulation, it has been a marked success. It has 25 miles of track, and is supplied with current from a power station by the River Kander. Energy is generated at 3,600 volts, which, by means of step-up transformers, is increased to 16,000 for the transmission line. At suitable points along the track the pressure is reduced to the line voltage of 750. The transmission line, which is 31 miles long, cost £27,000, and the track itself, including two overhead conductors, £870 per mile. The total working costs are extremely low, and an efficiency of 51 watts per ton-mile is obtained.

The Valtellina Railway, in Italy, is a further example of three-phase working, and has 67 miles of track, much of which is tunnelled or has had to be constructed under very great difficulty. The successful working of this line has shown both English and American engineers the possibilities of three-phase working for main line traffic. The energy is generated at 20,000 volts and is transformed to 3,000 volts for the trolley line. In the later type of locomotive twin motors are used, and are encased in one housing. They are mounted between the three driven axles and act on a connecting rod by means of cranks. In this way motion is communicated to the centre axle. The remaining two pairs of driving wheels are connected by outside coupling rods to the central pair. Cascade systems of control are used both on the old and new types of locomotive. A very complete series of tests has been carried out, and it was found that, after making due allowance for all transmission and other losses, an efficiency of 80 watt-hours per ton-mile was obtained. The motors gave an efficiency of 97 per cent. at full load, and the power factor was also 97 per cent.

An interesting feature of this line is the automatic cutting-off of current from insulated sections of the contact wires on each side of a station, when the signals are against a train coming into that station. Thus a driver attempting to run into a station with the signal set against him would immediately notice that the current was off, and, conversely, he would be unable to start up from a station against his signals.

One of the most recent instances of three-phase working is that of the Simplon tunnel. The total length of this line is 14 miles, 12½ of which are through the tunnel. Power is supplied from two hydraulic stations, one on either side, and is transmitted to the line at 3,300 volts pressure. Brown-Boveri locomotives are used, and the control is by means of secondary resistances in combination with a mode of altering the number of primary poles. The two running speeds are 42 and 21 miles per hour. The motors themselves are completely encased, so as to be unaffected by the moist air of the tunnel. Current is collected by means of bow collectors from the overhead conductors, and it is found that each bow requires relining after running about 2,000 miles. The locomotives weigh 62 tons in all, and have an adhesion weight of 44 tons on the driving wheels.

In the concluding part of the lecture, Prof. Kapp dealt with the question of single-phase working. It is now some years since this was first proposed by Mr. Ward-Leonard, and later in 1902 by Messrs. Mordey and Jenkin, in a paper read before the Institution of Civil Engineers.

The original Ward-Leonard system has been modified by the Oerlikon Co., of Switzerland, and it consists, in its present form, of a motor-generator system interposed between the trolley line and the train motors. Current from the line is taken to operate a single-phase motor, which is kept running continuously. This motor is coupled direct to a generator, which is separately excited for convenience of control. The generator in turn supplies current

to the train motors, and, as it is separately excited, regulation of speed is easily accomplished by means of an adjustable resistance in the exciter circuit. Were it not for its great weight the Ward-Leonard system would be practically perfect.

Reference was next made by the lecturer to the Seebach-Wettingen Railway constructed by the Oerlikon Co., and to the New Haven single-phase electrification which is now in progress. In England, the Victoria to London Bridge line, which is at present being electrified, is the chief example of single-phase work. In this instance the usual single overhead conductor will be used, whilst the rails will act as the second conductor and will be earthed. A.E.G. Winter-Eichberg motors of 115 H.P. each will be used, and accelerations of from 1·2—2·0 ft. per sec. per sec. will be obtained.

In conclusion, PROF. KAPP briefly referred to the Midland Railway line at Heysham, on which he stated a double catenary system of suspension is being used. The ground covered by the lecturer in these two discourses has been very extensive, and forms a comprehensive statement of the present position of railway electrification.

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

27,412A/07. "Improvements in electric arc lamps." H. BEVIS and A. E. ANGOLD. (Date applied for under Rule 13, December 12th, 1907.) January 13th.

5,506A/07. "Connection system for dynamo-electric machines." B. G. LAMME. (Date applied for under Sec. 91 of the Act, March 15th, 1906, being date of application in United States. An invention comprised in application No. 5,506, dated March 7th, 1907.) January 15th. (Complete.)

5,508A/07. "Connection system for dynamo-electric machines." B. G. LAMME. (Date applied for under Sec. 91 of the Act, August 2nd, 1906, being date of application in United States. An invention comprised in application No. 5,508, dated March 7th, 1907.) January 17th. (Complete.)

784. "Improvements in trolley pole contacts." E. SHELDON. January 13th.

796. "Improvements in electrically controlled apparatus for igniting and extinguishing lamps." A. M. AUBERT and J. M. AUBERT. January 13th. (Complete.)

811. "Improvements in insulating electric wires, cables and the like." J. E. GLENISTER and G. W. GLENISTER. January 13th.

851. "Improved automatic electric waste preventer for flushing water-closets and urinals." E. H. IRWIN. January 14th.

852. "Improvements relating to locking joints of drain and electrical machines and the like." R. GOODHIND, F. E. OWEN and E. BLACKMORE (trading as Francis E. Owen & Co.) January 14th.

854. "Single track signalling and train controlling system for railways." C. K. MILLS. (F. E. Kinsman, United States) January 14th. (Complete.)

865. "Improvements in electrolytic meters." W. B. THORPE. January 14th.

871. "Improvements relating to electric bells, induction coils or other electrically-operated vibrating appliances." B. A. PILKINGTON. January 14th.

873. "Improved method of controlling electric motors." H. C. E. JACOBY. January 14th.

877. "Improvements in automatic stopping devices for electric hoists." SIEMENS BROS. DYNAMO WORKS, LTD., and A. S. CLIFT. January 14th. (Complete.)

878. "Arrangement on electricity meters for determining the maximum consumption." SIEMENS BROS. DYNAMO WORKS, LTD. (Elektricitats Akt-Gesvormals Schuckert & Co., Germany.) January 14th. (Complete.)

880. "Improvements in or relating to electric lamp sockets or holding devices." A. J. BOULT. (Benjamin Electric Manufacturing Co., United States). January 14th. (Complete.)

889. "Improvements in and relating to radio-telephony." G. SEIBT and THE AMALGAMATED RADIO TELEGRAPH CO., LTD. (Date applied for under Sec. 91 of the Act, January 14th, 1907, being date of application in Germany.) January 14th. (Complete.)

892. "Improvements in and relating to alternating-current motors of the induction type." CROMPTON & CO., LTD., J. C. MACFARLANE and H. BURGE. January 14th.

893. "Improvements in or relating to alternate-current motors." V. A. FYNN. January 14th.

897. "Testing installation for electro-magnetically operated sparking plugs." R. BOSCH (trading as the firm of Robert Bosch). (Date applied for under Sec. 91 of the Act, March 22nd, 1907, being date of application in Germany.) January 14th. (Complete.)

898. "Improvements in bearings for electro-magnetic sparking machines." R. BOSCH (trading as the firm of Robert Bosch). (Date applied for under Sec. 91 of the Act, September 23rd, 1907, being date of application in Germany.) January 14th. (Complete.)

899. "Improvements in electric cable boxes or troughs." SIEMENS-SCHUCKERTWERKE G.m.b.H. (Date applied for under Sec. 91 of the Act, September 16th, 1907, being date of application in Germany.) January 14th. (Complete.)

936. "Preserving and fixing of telegraph telephone or other electric wires to insulators." J. MUNRO. January 15th.

949. "Improvements in electric batteries." F. RICHMOND. (Application for patent of addition to No. 3,962, 1907.) January 15th.

951. "Electrical connector for electric lamps and other apparatus." A. C. GREENE. January 15th.

956. "Improvements in electrical controlling mechanism, chiefly applicable for use with ships' steering gear." J. F. STOTT. January 15th.

957. "Improved sound receiver or telephone for the use of deaf people and the like." H. C. PAIN. January 15th.

977. "Improved gas governor (electrically fitted)." J. D. ALLATT. January 15th.

980. "Improvements in apparatus for straining telegraph, telephone and like wires." R. B. RANSFORD. (W. A. Manson, Natal.) January 15th.

996. "Improvements in dynamo-electric machinery." F. M. LEWIS. January 15th.

997. "Improvements in apparatus for the electro-deposition of metals." S. O. COWPER-COLES. January 15th.

1,003. "Improvements in electrical release devices for the control of electrical energy." H. S. MARTIN. January 15th.

1,005. "Improvements in secondary or storage batteries." H. W. LAKE. (C. H. Clare, United States.) January 15th. (Complete.)

1,019. "Improvement in electric cycle lamps." M. H. GOLDSTONE, J. H. WARD and A. GOLDSTONE. January 16th.

1,034. "Improvements in electrically-controlled locks and latches." T. O. SUMMERS, O. J. WOOTTON, T. HILL and W. H. GREEN (trading as the Reliable Lock and Brass Foundry Co.). January 16th.

1,118. "Improved method of lighting miners' safety lamps by electricity." W. PATTERSON. January 17th.

1,154. "Improvements in tiles, electric light casing, picture rails, and the like for fixing to or on a wall or partition." A. J. HOLLICK. January 17th.

1,159. "Improvement in regulating apparatus for alternating-current circuits." W. H. THOMPSON. (Date applied for under Sec. 91 of the Act, February 2nd, 1907, being date of application in United States.) January 17th. (Complete.)

1,178. "Improvements in or relating to frictional blocks, such as brake blocks, electrical collector slippers and the like." C. C. W. SIMPSON. January 17th.

1,187. "Improvements in and relating to electric conductors and collectors for electric railways and tramways." R. C. THOMSON. (D. Kempt, Argentine Republic.) January 18th.

1,203. "Improvements in connection with the telegraphic transmission of photographs and the like." F. WYNDHAM. January 18th.

1,209. "Transmission and reproduction of pictorial representations by electrical agency." J. J. PEARSON. January 18th.

1,221. "Improvements in trol eys or collectors for electric railways and tramways." H. J. TOMPKINS. January 18th.

1,239. "Improvements in suspending devices for electric conductors." R. L. HOFFMAN. (Date applied for under Sec. 91 of the Act, October 8th, 1907, being date of application in United States. January 18th. (Complete.)

1,240. "Improvements in suspension devices for electric conductors." F. GUILLOT. (Date applied for under Sec. 91 of the Act, October 10th, 1907, being date of application in United States.) January 18th. (Complete.)

1,241. "Improved means for maintaining a regular tension on railway signal wires." J. M. KAY. January 18th. (Complete.)

1,252. "Improvements in electro-magnetic devices for use on alternating-current circuits." M. B. FIELD and FERRANTI, LTD. January 18th.

1,250. "Improvements in and relating to electrically-driven mining machines." P. JENSEN. (J. A. Jeffrey, United States.) January 18th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool; price, post free, 9d. (in stamps).

1906.

SYSTEMS OF OPERATING ELECTRIC MOTORS FOR BRAKING PURPOSES. British Thomson-Houston Co. (General Electric Co., United States.) 20,928. September 20th.

MANUFACTURE OF ELECTRIC CONDUCTORS OF REFRACTORY METAL, APPLICABLE MORE ESPECIALLY FOR USE AS INCANDESCING BODIES IN ELECTRIC LAMPS. British Thomson-Houston Co. (General Electric Co., United States.) 21,504. September 28th.

ELECTRIC MOTOR CONTROL SYSTEMS AND APPARATUS. British Thomson-Houston Co. (General Electric Co., United States.) 23,894. October 26th.

ELECTRICAL CONDUIT AND JUNCTION BOX FITTINGS. H. Hirst and U. S. Gunner. 23,944. October 27th.

ELECTRIC SUPPLY SYSTEMS. H. Leitner. 26,644. November 23rd.

ELECTRIC MOTORS. H. Leitner. 29,174. December 21st.

ELECTRIC SWITCH. H. Lubeck. 29,320. December 24th.

CIRCUIT-CONTROLLING MECHANISM. British Thomson-Houston Co. (General Electric Co., United States.) 29,584. December 28th.

SECTIONAL POLES FOR TELEPHONE, TELEGRAPH AND TROLLEY WIRES. H. M. Sciple. 29,618. December 29th.

ELECTRIC CIRCUIT BREAKERS. W. H. Scott. 29,639. December 29th.

RETARDING DEVICES OR DASHPOTS MORE ESPECIALLY INTENDED FOR USE WITH ELECTRIC CIRCUIT BREAKERS. W. H. Scott. 29,639A. December 29th. (Date applied for under Rule 5, Patents Rules 1905, December 29th, 1906.)

ELECTRIC CIRCUIT BREAKERS OR SWITCHES. W. H. Scott. 29,639B. December 29th. (Date applied for under Rule 5, Patents Rules 1905, December 29th, 1906.)

ELECTROLYTIC APPARATUS. H. Ruthenburg. 29,655. December 29th.

ELECTRICAL APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS. A. T. Dawson and G. T. Buckham. 29,665. December 29th.

SYSTEMS OF ELECTRIC TRAIN LIGHTING. H. Leitner. 29,758. December 31st.

1907.

AUTOMATIC ELECTRIC MOTOR STARTER. W. D. Kilroy and Evershed & Vignoles, Ltd. 793. January 11th.

ELECTRIC SERVICE MOTORS. H. Couade. 1,686. January 22nd. (Date applied for under International Convention, January 23rd, 1906.)

ELECTRICAL DEVICES FOR EXHIBITING ADVERTISEMENTS. C. C. Hewett and W. F. Foster. 2,029. January 26th.

ELECTRICAL INSULATORS FOR TELEGRAPH OR TELEPHONE WIRES OR THE LIKE. T. F. Purves and J. Sinnott. 2,959. February 6th.

METHOD AND MEANS FOR ACTUATING ELECTRO-MECHANICAL FOG SIGNALS FOR RAILWAYS. G. Lowthian. 2,973. February 6th.

LOCKS AND ELECTRICAL SWITCHES CONNECTED THEREWITH. R. Tiercelin. 3,212. February 8th. (Date applied for under International Convention, September 20th, 1906.)

AUTOMATIC PERIODICALLY-OPERATED ELECTRIC SWITCHES. J. Gunning. 3,613. February 13th.

ELECTRIC CRANES, WINCHES AND THE LIKE. Sunderland Forge and Engineering Co. and W. Blair. 3,908. February 16th.

DYNAMO-ELECTRIC IGNITION APPARATUS OF INTERNAL-COMBUSTION ENGINES. Electric Ignition Co. and F. H. Hall. 3,997. February 18th.

SIGNALLING SYSTEMS FOR RAILWAYS AND THE LIKE. British Thomson-Houston Co. (General Electric Co., United States.) 6,134. March 13th.

COIN-FREED MECHANISM FOR GAS, WATER AND ELECTRICITY METERS. R. Ulrich. 7,065. March 21st. (Date applied for under International Convention, March 22nd, 1906.)

INDUCTOR ALTERNATORS. J. L. Milton. 8,173A. September 13th. (Date applied for under Rule 5, Patents Rules 1905, April 8th, 1907.)

APPARATUS FOR WIRELESS TELEGRAPHY. G. Marconi and Marconi's Wireless Telegraph Co. 8,462. April 11th.

APPARATUS FOR WIRELESS TELEGRAPHY. G. Marconi and Marconi's Wireless Telegraph Co. 8,463. April 11th.

MEANS OF PROPULSION OF ELECTRICALLY-DRIVEN TRAINS AND THE LIKE. S. Stone and L. W. Migotti. 8,623. April 13th.

WIRELESS TELEGRAPHY. F. W. Le Tall. (P. C. Hewitt.) 10,259. May 2nd.

TELEGRAPH OR SIGNALLING SYSTEM AND APPARATUS. P. M. Justice. (Sub-Target Gun Co., United States.) 15,582. July 8th.